FINAL

PHASE I RFI/RI WORK PLAN

ROCKY FLATS PLANT
100 AREA
(OPERABLE UNIT NO. 13)

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

OCTOBER, 1992
(Revised March 10, 1993)

Volume I of III
Text

U. NU

REVIEWED FOR CLASSIFICATION/UCNI
BY G. T. Ostdiek
DATE 3-31-93

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OPERABLE UNIT 13 FIGURES 6-4 THROUGH 6-10

In order to minimize multiple reiterations of expensive color copies, only black and white copies were included in this submittal. If the changed figures are acceptable to CDH and EPA, final color copies will be transmitted within seven working days.

TITLE: Benchmarks

Approved By:

04/01/93
Effective Date

Manager

/ /
Date

3.0 ROCKY FLATS PLANT CHEMICAL SPECIFIC BENCHMARKS

Tables 3.1 through 3.4 provide a preliminary identification of potential chemical-specific Benchmarks for groundwater, surface water, air, and soil at RFP. EPA analytical methods and detection limits have been specified for soil analyses to obtain data of the highest quality with the lowest possible detection limits. The Benchmarks included in this section were developed for the entire Rocky Flats Plant site and are not specific to OU 13. Site specific ARARs will be developed as the initial step of the Feasibility Study/Corrective Measures Study for OU 13. As validated data become available from RFI/RI investigations obtained pursuant to this Work Plan, the Benchmarks will be reevaluated in accordance with Chapter Three, Part 15 of the IAG (DOE, 1991a). The site-wide Benchmarks included in this work plan are not intended for use in establishing cleanup goals; however, they will be used to establish RFI/RI analytical detection limits. Cleanup criteria for OU 13 will be site specific and shall be based on results of an environmental and human-based Risk Assessment.

The tables are a master list of possible contaminants which may be present across the entire Rocky Flats Plant site. This list provides identification of the compound, a listing of federal and state regulations that may apply to that compound, the Practical Quantitation Limit (PQL), which is the level at which the amount of analyte can be reliably measured, and the method of analysis which the PQL is based upon.

In some cases the Minimum Detection Limit (MDL) is listed instead of the PQL. The MDL is the lowest concentration at which the analyte can be detected but not necessarily measured.

Rocky Flats has been following the historical CERCLA/RCRA procedure of utilizing transitional EPA Contract Analytical Program (CLP) Routine Analytical Service protocol for Phase 1 study. This methodology is described as a managed approach whereby:

1. The benchmark table will be used in the Phase I investigations in conjunction with the CLP-RAS analytical methods to scope the initial RFI/RI investigation[1].

2. Following receipt and analysis of all field investigation data, a weight-of-evidence evaluation will be used to assess the adequacy of the analytical program relative to study objectives[2].

3. If the weight-of-evidence evaluation suggests that a particular compound or group of compounds warrant further assessment at lower quantitation limits, then follow up sampling and analysis with Special Analytical Services (SAS) will be performed as necessary.

Site wide Benchmarks represented in Table 3.1 through 3.4 were developed from the following

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1 CLP-RAS methods are the workhorses of the hazardous waste industry. Collectively, a full CLP-RAS suite includes 126 organic (and a specified number of Tentatively Identified Compounds (TICs), and 25 inorganic compounds. Standard radiochemistry analysis includes 12 radioisotopes. These broad-brush methods provide a reasonable trade-off between specificity (the number of compounds detectable) and sensitivity (detection limit). It is standard practice to utilize CLP-RAS methods in the first phase of a study where contaminant identification is emphasized more than quantitation. Following identification of contaminants of concern, follow up sampling and analysis with a more sensitive method can be performed if quantitation is still an issue. This step-wise methodology was used in the OU 1 881 Hillside Phase III study and the OU 2 903 Pad and East Trenches, Phase II study.

2 The weight-of-evidence evaluation will consider factors such as the number of detections of specific chemicals, observed concentration range, fate and transport characteristics, their occurrence-distribution and concentration relative to overall site risk, as well as likely ARAR determination.

sources:

- Colorado Department of Health (CDH), Water Quality Control Commission (WQCC), groundwater standards;

- Safe Drinking Water Act (SWADA), Maximum Contaminant Levels (MCLs), surface water and groundwater;

- Clean Water Act (CWA), Ambient Water Quality Criteria (AWQC), potentially applicable to surface water and groundwater;

- RCRA, Subpart F, Groundwater Concentration Limits (40 CFR 264.94), groundwater standards; and

- CDH, WQCC proposed statewide and classified groundwater area standards.

In instances where Benchmarks have not been proposed for a particular chemical or for a particular type of investigative method, EG&G's General Radiochemistry and Routine Analytical Services Protocol (GRRASP) or other appropriate laboratory procedures will be considered as the practical quantitation limits and will be applied.

TABLE 3.1
BENCHMARKS

TABLE A - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS					STATE STANDARDS							
								CDH WQCC Groundwater Quality Standards (d)							
								Statewide	Site-Specific (g)						
Parameter	Type (4)	Method (5)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (6)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chloride	Table 6 Radionuclides Woman Creek	Table 6 Radionuclides Walnut Creek
Chloride	A	E325	250,000 * (a)							250,000					
Cyanide (Free)	A	E335	200 (h)		200 (h)				200						
Fluoride	A	E340	4,000; 2,000* (a)		4,000 (a)				4,000		2,000				
N as Nitrate	A	E353.1		10,000 (b)		10,000 (b)			10,000						
N as Nitrate+Nitrite	A	E353.1		10,000 (b)		10,000 (b)					100,000				
N as Nitrite	A	E354.1		1,000 (b)		1,000 (b)			1,000		10,000				
Sulfate	A	E375.4	250,000* (a)							250,000					
Sulfide, H2S Undissociated	A	E376.1													
Coliform (Fecal)	B	SM9221C	1/100 ml (a)***						1/100 ml						
Ammonia as N	C	E350													
Dioxin	D	(5)	3.0E-5 (h)		0 (h)			0.00000022					1.3E-08		
Boron	E	SW6010(SB)									750				
Chlorine, Total Residual	E	SM4500													
Sulfur	E														
Dissolved Oxygen	FP	SM4500													
pH (Standard Units)	FP	E150.1	6.5-8.5 * (a)							6.5-8.5	6.5-8.5				
Specific Conductance	FP	E120.1													
Temperature (Degrees Celsius)	FP														
Alkalinity	IN	E310.1													
Asbestos	IN			7MFA (b)		7MFA (b)									
Total Dissolved Solids (TDS)	IN	E160.1	500,000* (a)									400,000 (1)			
Total Organic Carbon (TOC)	IN	E415.1													
Aluminum	M	(5)		50 to 200* (b)							5,000				
Antimony	M	(5)	6 (h)		6 (h)										
Arsenic	M	(5)	50 (a)				50		50		100				
Arsenic III	M														
Arsenic V	M														
Barium	M	(5)	2,000 (e)			2,000 (e)	1,000		1,000						
Beryllium	M	(5)	4 (h)		4 (h)						100				
Cadmium	M	(5)	10 (a)	5 (b)		5 (b)	10		10		10				
Calcium	M	(5)													
Cesium	M	(5)													
Chromium	M	(5)	50 (a)	100 (b)		100 (b)	50		50		100				
Chromium III	M														
Chromium VI	M	E218.5													
Cobalt	M	(5)									50				
Copper	M	(5)	1,000 * (a)	1,300 (f)		1,300 (f)				1,000	200				
Iron	M	(5)	300 * (a)							300	5,000				
Lead	M	(5)	50 (a)	15 (f)		0 (f)	50		50		100				
Lithium	M	(5)									2,500				
Magnesium	M	(5)													
Manganese	M	(5)	50 * (a)							50	200				
Mercury	M	(5)	2 (a)	2 (b)		2 (b)	2		2		10				
Molybdenum	M	(5)													
Nickel	M	(5)	100 (h)		100 (h)						200				
Potassium	M	(5)													
Selenium	M	(5)	10 (a)	50 (b)		50 (b)	10		10		20				
Silver	M	(5)	50 (a)	100 * (b)			50		50						
Sodium	M	(5)													
Strontium	M	(5)													
Thallium	M	(5)	2 (h)		0.5 (h)										
Tin	M	(5)													
Titanium	M	SW6010(SB)													
Tungsten	M	SW6010(SB)													
Vanadium	M	(5)									100				
Zinc	M	(5)	5,000 * (a)							5,000	2,000				
Aldicarb	P		3 (f)		1 (f)			10							
Aldicarb Sulfone	P		2 (f)		1 (f)		–								

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			FEDERAL STANDARDS					STATE STANDARDS							
								CDH WQCC Groundwater Quality Standards (d)							
								Statewide	Site-Specific (g)						
Parameter	Type (4)	Method (5)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (6)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides Woman Creek	Table 6 Radionuclides Walnut Creek
Aldicarb Sulfoxide	P		4 (f)		1 (i)										
Aldrin	P	(5)						0.002					0.0000784		
Carbofuran	P	(5C)		40 (b)		40 (b)		30							
Chloranil	P														
Chlordane	P	(5)		2 (b)		0 (b)		0.03					0.00046		
Chlorpyifos	P	(5)													
DDT	P	(5)						0.1					0.000024		
DDT Metabolite (DDD)	P	(5)													
DDT Metabolite (DDE)	P	(5)						0.1							
Demeton	P	(5)													
Diazinon	P	(5)													
Dieldrin	P	(5)						0.002					0.000071		
Endosulfan I	P	(5)													
Endosulfan II	P	(5)													
Endosulfan sulfate	P	(5)													
Endrin	P	(5)	2 (h)		2 (h)		0.2	0.2							
Endrin Aldehyde	P	(5B)						0.2							
Endrin Ketone	P	(5B)													
Guthion (Azinphos methyl)	P	(5)													
Heptachlor	P	(5)		0.4 (b)		0 (b)		0.008					0.00028		
Heptachlor Epoxide	P	(5)		0.2 (b)		0 (b)		0.09							
Hexachlorocyclohexane, Alpha	P	(5)						0.006					0.0092		
Hexachlorocyclohexane, Beta	P	(5)											0.0163		
Hexachlorocyclohexane (HCH or BHC)	P														
Hexachlorocyclohexane, Delta	P	(5)													
Hexachlorocyclohexane, Technical (Total)	P	(5E)											0.0123		
Hexachlorocyclohexane, Gamma (Lindane)	P	(5)	4 (a)	0.2 (b)		0.2 (b)	4.0	0.2					0.0186		
Malathion	P	(5B)													
Methoxychlor	P	(5)	100 (a)	40 (b)		40 (b)	100	40							
Mirex	P														
Oxamyl (Vydate)	P		200 (h)		200 (h)										
Parathion	P	(5B)													
Toxaphene	P	(5)		3 (b)		0 (b)	5.0	0.03							
Vaponite 2	P														
Aroclor 1016	PP	(5)													
Aroclor 1221	PP	(5)													
Aroclor 1232	PP	(5)													
Aroclor 1242	PP	(5)													
Aroclor 1248	PP	(5)													
Aroclor 1254	PP	(5)													
Aroclor 1260	PP	(5)													
PCBs (Total)	PP	(5)		0.5 (b)		0 (b)		0.005					0.000079		
2,4,5-TP Silvex	H	(5C)	10 (a)	50 (b)		50 (b)	10	50							
2,4-Dichlorophenoxyacetic Acid (2,4-D)	H	(5C)	100 (a)	70 (b)		70 (b)	100	70							
Acrolein	H														
Atrazine	H	(5D)		3 (b)		3 (b)							3		
Bromacil	H														
Dalapon	H	(5)	200 (h)		200 (h)										
Dinoseb	H	(5)	7 (h)		7 (h)										
Diquat	H		20 (h)		20 (h)										
Endothall	H		100 (h)		100 (h)										
Glyphosate	H		700 (h)		700 (h)										
Picloram	H		500 (h)		500 (h)										
Simazine	H	(5D)	4 (h)		4 (h)								4		
Americium (total)(pCi/l)	R													0.05	0.05
Americium 241 (pCi/l)	R														
Cesium 134 (pCi/l)	R		(8)					80						80	80
Cesium 137 (pCi/l)	R		(8)												
Gross Alpha (pCi/l)	R		15 (a)(7)						15(7)					7	11
Gross Beta (pCi/l)	R		50 (a)(2)(8)						(8)					5	19
Plutonium (total)(pCi/l)	R													0.05	0.05
Plutonium 238+239+240 (pCi/l)	R							15						15	15

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Radium 226+228 (pCi/l)	R	(3)	20 (a)(8)					5						5	5
Strontium 89+90 (pCi/l)	R		(a)(2)(8)												
Strontium 90 (pCi/l)	R		8 (a)(2)(8)					8						8	8
Thorium 230+232 (pCi/l)	R		(a)(8)					60						60	60
Tritium (pCi/l)	R		20,000 (a)(2)(8)					20,000						500	500
Uranium 233+234 (pCi/l)	R														
Uranium 235 (pCi/l)	R														
Uranium 238 (pCi/l)	R														
Uranium (Total) (pCi/l)	R													5	10
1,2,4,5-Tetrachlorobenzene	SV	(5B)						2							
1,2,4-Trichlorobenzene	SV	(5)	70 (h)		70 (h)										
1,2-Dichlorobenzene (Ortho)	SV	(5)		600 (b)		600 (b)		620							
1,2-Diphenylhydrazine	SV	(5B)						0.05							
1,3-Dichlorobenzene (Meta)	SV	(5)						620							
1,4-Dichlorobenzene (Para)	SV	(5)	75 (a)		75 (a)			75							
2,4,5-Trichlorophenol	SV	(5)													
2,4,6-Trichlorophenol	SV	(5)						2					1.2		
2,4-Dichlorophenol	SV	(5)						21							
2,4-Dimethylphenol	SV	(5)													
2,4-Dinitrophenol	SV	(5)						14							
2,4-Dinitrotoluene	SV	(5)													
2,6-Dinitrotoluene	SV	(5)													
2-Chloronaphthalene	SV	(5)													
2-Chlorophenol	SV	(5)													
2-Methylnaphthalene	SV	(5)													
2-Methylphenol	SV	(5)													
2-Nitroaniline	SV	(5)													
2-Nitrophenol	SV	(5)													
3,3'-Dichlorobenzidine	SV	(5)													
3-Nitroaniline	SV	(5)													
4,6-Dinitro-2-methylphenol	SV	(5)													
4-Bromophenyl-phenyl-ether	SV	(5)													
4-Chloroaniline	SV	(5)													
4-Chlorophenyl-phenyl-ether	SV	(5)													
4-Chloro-3-methylphenol	SV	(5)													
4-Methylphenol	SV	(5)													
4-Nitroaniline	SV	(5)													
4-Nitrophenol	SV	(5)													
Acenaphthene	SV	(5)													
Anthracene	SV	(5)													
Benzidine	SV	(5bc)						0.0002					0.00012		
Benzoic Acid	SV	(5)													
Benzo(a)anthracene	SV	(5)													
Benzo(a)pyrene	SV	(5)	0.2 (h)		0 (h)										
Benzo(b)fluoranthene	SV	(5)													
Benzo(g,h,i)perylene	SV	(5)													
Benzo(k)fluoranthene	SV	(5)													
Benzyl Alcohol	SV	(5)													
bis(2-Chloroethoxy)methane	SV	(5)													
bis(Chloroethyl)ether	SV	(5)						0.03					0.0000037		
bis(2-Chloroisopropyl)ether	SV	(5)													
bis(2-Ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	SV	(5)	6 (h)		0 (h)										
Butadiene	SV														
Butylbenzylphthalate	SV	(5)													
Chlorinated Ethers	SV	(5)													
Chlorinated Napthalenes	SV	(5)													
Chloroalkylethers	SV	(5)													
Chlorophenol (Total)	SV	(5)							1						
Chrysene	SV	(5)													
Dibenzofuran	SV	(5)													
Dibenz(a,h)anthracene	SV	(5)													
Dichlorobenzenes	SV	(5)													
Dichlorobenzidine (Total)	SV	(5)											0.01		

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Parameter	Type (4)	Method (5)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (f)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Table 6 Radionuclides Woman Creek	Table 6 Radionuclides Walnut Creek
Diethylphthalate	SV	(5)													
Di(2-ethylhexyl)adipate	SV	(5)	400 (h)		400 (h)										
Dimethylphthalate	SV	(5)													
Di-n-butylphthalate	SV	(5)													
Di-n-octylphthalate	SV	(5)													
Ethylene Glycol	SV	(SC)													
Fluoranthene	SV	(5)													
Fluorene	SV	(5)													
Formaldehyde	SV														
Haloethers	SV	(5)													
Hexachlorobenzene	SV	(5)	1 (h)		0 (h)			0					0.00072		
Hexachlorobutadiene	SV	(5)						1					0.45		
Hexachlorocyclopentadiene	SV	(5)	50 (h)		50 (h)										
Hexachloroethane	SV	(5)											1.9		
Hydrazine	SV														
Indeno(1,2,3-cd)pyrene	SV	(5)													
Isophorone	SV	(5)						1,050							
Naphthalene	SV	(5)													
Nitrobenzene	SV	(5)						3.5							
Nitrophenols	SV	(5)													
Nitrosamines	SV	(5)													
N-Nitrosodibutylamine	SV	(5B)											0.0064		
N-Nitrosodiethylamine	SV	(5B)											0.0008		
N-Nitrosodimethylamine	SV	(5B)											0.0014		
N-Nitrosopyrrolidine	SV	(5B)											0.016		
N-Nitrosodiphenylamine	SV	(5B)											4.9		
N-Nitroso-di-n-propylamine	SV	(5B)													
Pentachlorinated Ethanes	SV	(5B)													
Pentachlorobenzene	SV	(5B)						6 (f)							
Pentachlorophenol	SV	(5)		1 (e)		0 (e)		200							
Phenanthrene	SV	(5)													
Phenol	SV	(5)							1						
Phthalate Esters	SV	(5)													
Polynuclear Aromatic Hydrocarbons	SV	(5)											0.0028		
Pyrene	SV	(5)													
Vinyl Chloride	V	(5)	2 (a)		0 (a)			2							
1,1,1-Trichloroethane	V	(5)	200 (a)		200 (a)			200							
1,1,2,2-Tetrachloroethane	V	(5)											0.17		
1,1,2-Trichloroethane	V	(5)	5 (h)		3 (h)			3					0.6		
1,1-Dichloroethane	V	(5)													
1,1-Dichloroethene	V	(5)	7 (a)		7 (a)			7							
1,2-Dichloroethane	V	(5)	5 (a)		0 (a)			0.4							
1,2-Dichloroethene (cis)	V	(5)		70 (b)		70 (b)		70							
1,2-Dichloroethene (total)	V	(5)													
1,2-Dichloroethene (trans)	V	(5)		100 (b)		100 (b)		100							
1,2-Dichloropropane	V	(5)		5 (b)		0 (b)		0.56							
1,3-Dichloropropene (cis)	V	(5)													
1,3-Dichloropropene (trans)	V	(5)													
2-Butanone	V	(5)													
2-Hexanone	V	(5)													
4-Methyl-2-pentanone	V	(5)													
Acetone	V	(5)													
Acrylonitrile	V	(5)											0.058		
Benzene	V	(5)	5 (a)		0 (a)			1							
Bromodichloromethane	V	(5)	<100** (a)					0.3							
Bromoform	V	(5)	<100** (a)					4							
Bromomethane	V	(5)													
Carbon Disulfide	V	(5)													
Carbon Tetrachloride	V	(5)	5 (a)		0 (a)			0.3							
Chlorinated Benzenes	V/SV	(5)													
Chlorobenzene	V	(5)		100 (b)		100 (b)		100							
Chloroethane	V	(5)													
Chloroform	V	(5)	<100** (a)					6					0.19		

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Chloromethane	V	(5)													
Dibromochloromethane	V	(5)	<100** (a)					14							
Dichloroethenes	V	(5)													
Ethyl Benzene	V	(5)		700 (b)		700 (b)		680							
Ethylene Dibromide	V	(5C)		0.05 (b)		0 (b)									
Ethylene Oxide	V														
Halomethanes	V	(5)	100 (a)										0.19		
Methylene Chloride	V	(5)	5 (h)		0 (h)										
Styrene	V	(5)		100 (b)		100 (b)									
Tetrachloroethanes	V	(5)													
Tetrachloroethene	V	(5)		5 (b)		0 (b)		5					0.8		
Toluene	V	(5)		1,000 (b)		1,000 (b)		1,000							
Trichloroethanes	V	(5)													
Trichloroethene	V	(5)	5 (a)		0 (a)			5							
Vinyl Acetate	V	(5)													
Xylenes (total)	V	(5)		10,000 (b)		10,000 (b)									

EXPLANATION OF TABLE AND ENDNOTES

* = secondary maximum contaminant level; TBCs
** = total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
*** = Positive sample no more than once/month (<40 samples/month)

ARAR = Applicable on Relevant and Appropriate Requirement
CDH = Colorado Department of Health
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
EPA = Environmental Protection Agency
NCP = National Contingency Plan
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
RFP = Rocky Flats Plant
SDWA = Safe Drinking Water Act
SW = Solid Waste
TIC = Tentatively Identified Compound
ug/l = micrograms per liter
WQCC = Water Quality Control Commission
MF/l = million fibers/liter

(1) TDS standard - see Table 4 in (d); standard is 400 mg/l or 1.25 times the background level, whichever is least restrictive
(2) If both strontium-90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 mrem/yr
(3) MDL for Radium 226 is 0.5; MDL for radium 228 is 1
(4) Type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; FP=field parameter; H=herbicide; IN=inorganic; M=metal; P=pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile
(5) See Attachment 1 for analytical methods with corresponding analytes and detection limits
abbreviations are: E=EPA; SW=SW846; A=detected as total; B=detected as TICs or with method modifications; C=not routinely monitored; D=monitored in discharge ponds; E=mixture-individual isomers detected
(6) Where the standard is below (more stringent than) the PQL, the PQL is interpreted to be compliance level
(7) Value for gross alpha excludes uranium
(8) Average annual concentration of beta particles and photon radioactivity cannot exceed 4 millirem/year dose equivalent

(a) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of 5/19/90)
(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective July 30, 1992 (56 Federal Register 3526; 1/30/1991)
(c) NCP, 40 CFR 300; NCP Preamble 55 FR 8704; CERCLA Compliance with Other Laws Manual, EPA/540/G-89/006, August 1988, 40 CFR 264.94
(d) CDH/Water Quality Control Commission, The Basic Standards for Ground Water, 3.11.0 (5 CCR 1002-8) 1/5/1987 effective 11/30/1991; statewide radioactive standards listed in 3.11.5(c)(2)
(e) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective January 1, 1993 (56 FR 30266; 7/1/1991)
(f) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142 (56 FR 26460; 6/7/91), and 57 FR 28785; 6/29/92 effective 12/7/92 and 11/6/91. Action levels effective 12/7/92; MCLGs effective 11/6/91. Action level in 10% or less of tap samples for small and medium-sized systems.
(g) CDH/Water Quality Control Commission, Classifications and Water Quality Standards for Ground Water, 3.12.0 (9/19/1991)
(h) EPA National Primary Drinking Water Regulations, 40 CFR 141 and 142, Final Rule, Effective January 17, 1994
(i) EPA National Primary Drinking Water Regulations, 40 CFR 141, Postponement of Final Rule and Reconsideration (57 FR 22178) - no effective date established.

TABLE B - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
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Parameter	Type (7)	Method (8)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
							Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Chloride	A	E325	250,000 * (a)				860,000(g)	230,000(g)		
Cyanide (Free)	A	E335	200 (h)		200 (h)		22	5.2	200	
Flouride	A	E340	4,000; 2,000* (a		4,000 (a)					
N as Nitrate	A	E353.1		10,000 (b)		10,000 (b)			10,000	
N as Nitrate+Nitrite	A	E353.1		10,000 (b)		10,000 (b)				
N as Nitrite	A	E354.1		1,000 (b)		1,000 (b)				
Sulfate	A	E375.4	250,000* (a)							
Sulfide, H2S Undissociated	A	E376.1						2		
Coliform (Fecal)	B	SM9221C	1/100 ml (a)							
Ammonia as N	C	E350					***			
Dioxin	D	(8)	3.0E-5 (h)		0 (h)		0.01	0.00001	0.000000013	0.000000014
Boron	E	SW6010(8								
Chlorine, Total Residual	E	SM4500					19	11		
Sulfur	E									
Dissolved Oxygen	FP	SM4500					5,000			
pH (Standard Units)	FP	E150.1	6.5-8.5 * (a)					6.5-9		
Specific Conductance	FP	E120.1								
Temperature (Degrees Celsius)	FP						SS	SS		
Alkalinity	IN	E310.1						20,000		
Asbestos	IN			7MF/l (b)		7MF/l (b)				300,000 F/L*
Total Dissolved Solids	IN	E160.1	500,000* (a)				SS	SS	250,000	
Total Organic Carbon	IN	E415.1								
Aluminum	M	(8)		50 to 200* (b)			750	87		
Antimony	M	(8)	6 (h)		6 (h)		9,000	1,600	146	45,000
Arsenic	M	(8)	50 (a)						0.0022	0.0175
Arsenic III	M						360	190		
Arsenic V	M						850	48		
Barium	M	(8)	2,000 (e)		2,000 (e)				1,000	
Beryllium	M	(8)	4 (h)		4 (h)		130	5.3	.0068**	.117**
Cadmium	M	(8)	10 (a)	5 (b)		5 (b)	3.9 (3)	1.1 (3)	10	
Calcium	M	(8)								
Cesium	M	(8)								
Chromium	M	(8)	50 (a)	100 (b)		100 (b)				
Chromium III	M						1,700 (3)	210 (3)	170,000	3,433,000
Chromium VI	M	E218.5					16	11	50	
Cobalt	M	(8)								
Copper	M	(8)	1,000 * (a)	1,300 (f)		1,300 (f)	18 (3)	12 (3)		
Iron	M	(8)	300 * (a)					1,000	300	
Lead	M	(8)	50 (a)	15 (f)		0 (f)	82 (3)	3.2 (3)	50	

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							Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Lithium	M	(8)								
Magnesium	M	(8)								
Manganese	M	(8)	50 * (a)						50	100
Mercury	M	(8)	2 (a)	2 (b)		2 (b)	2.4	0.012	0.144	0.146
Molybdenum	M	(8)								
Nickel	M	(8)	100 (h)		100 (h)		1,400 (3)	160 (3)	13.4	100
Potassium	M	(8)								
Selenium	M	(8)	10 (a)	50 (b)		50 (b)	20 (d)	5 (d)	10	
Silver	M	(8)	50 (a)	100* (b)			4.1 (3)	0.12	50	
Sodium	M	(8)								
Strontium	M	(8)								
Thallium	M	(8)	2 (h)		0.5 (h)		1,400 (1)	40 (1)	13	48
Tin	M	(8)								
Titanium	M	SW6010(8								
Tungsten	M	SW6010(8								
Vanadium	M	(8)								
Zinc	M	(8)	5,000 * (a)				120 (3)	110 (3)		
Aldicarb	P		3 (i)		1 (i)					
Aldicarb Sulfone	P		2 (i)		1 (i)				10	
Aldicarb Sulfoxide	P		4 (i)		1 (i)				100	
Aldrin	P	(8)					3.0		0.000074	0.000079
Carbofuran	P	(8C)		40 (b)		40 (b)				
Chloranil	P									
Chlordane	P	(8)		2 (b)		0 (b)	2.4	0.0043	0.00046	0.00048
Chlorpyifos	P	(8)					0.063	0.041		
DDT	P	(8)					1.1	0.001	0.000024	0.000024
DDT metabolite (DDD)	P	(8)					0.06			
DDT metabolite (DDE)	P	(8)					1,050			
Demeton	P	(8)						0.1		
Diazinon	P	(8)								
Dieldrin	P	(8)					2.5	0.0019	0.000071	0.000076
Endosulfan I	P	(8)					0.22	0.056	74	159
Endosulfan II	P	(8)								
Endosulfan Sulfate	P	(8)								
Endrin	P	(8)	2 (h)		2 (h)		0.18	0.0023	1	
Endrin Aldehyde	P	(8B)								
Endrin Ketone	P	(8B)								
Guthion (Azinphos methyl)	P	(8)						0.01		
Heptachlor	P	(8)		0.4 (b)		0 (b)	0.52	0.0038	0.00028	0.00029
Heptachlor Epoxide	P	(8)		0.2 (b)		0 (b)				
Hexachlorocyclohexane, Alpha	P	(8)							0.0092	0.031
Hexachlorocyclohexane, Beta	P	(8)							0.0163	0.0547
Hexachlorocyclohexane (HCH or BHC)	P						100			

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Hexachlorocyclohexane, Delta	P	(8)								
Hexachlorocyclohexane, Technical (Total)	P	(8E)							0.0123	0.0414
Hexachlorocyclohexane, Gamma (Lindane)	P	(8)	4 (a)	0.2 (b)		0.2 (b)	2	0.08	0.0186	0.0625
Malathion	P	(8B)						0.01		
Methoxychlor	P	(8)	100 (a)	40 (b)		40 (b)		0.03	100	
Mirex	P							0.001		
Oxamyl (Vydate)	P		200 (h)		200 (h)			0.001		
Parathion	P	(8B)					0.065	0.013		
Toxaphene	P	(8)		3 (b)		0 (b)	0.73	0.0002	0.00071**	0.00073**
Vaponite 2	P									
Aroclor 1016	PP	(8)								
Aroclor 1221	PP	(8)								
Aroclor 1232	PP	(8)								
Aroclor 1242	PP	(8)								
Aroclor 1248	PP	(8)								
Aroclor 1254	PP	(8)								
Aroclor 1260	PP	(8)								
PCBs (Total)	PP	(8)		0.5 (b)		0 (b)	2	0.014	0.000079**	0.000079**
2,4,5-TP Silvex	H	(8C)	10 (a)	50 (b)		50 (b)			10	
2,4-Dichlorophenoxyacetic Acid (2,4-D)	H	(8C)	100 (a)	70 (b)		70 (b)			100	
Acrolein	H						68(1)	21(1)	320	780
Atrazine	H	(8D)		3 (b)		3 (b)				
Bromacil	H									
Dalapon	H	(8)	200 (h)		200 (h)					
Dinoseb	H	(8)	7 (h)		7 (h)					
Diquat	H		20 (h)		20 (h)					
Endothall	H		100 (h)		100 (h)					
Glyphosate	H		700 (h)		700 (h)					
Picloram	H		500 (h)		500 (h)					
Simazine	H	(8D)	4 (h)		4 (h)					
Americium (total)(pCi/l)	R									
Americium 241 (pCi/l)	R									
Cesium 134 (pCi/l)	R		(4)							
Cesium 137 (pCi/l)	R		(4)							
Gross Alpha (pCi/l)	R		15 (a)(9)							
Gross Beta (pCi/l)	R		50 (a)(4)(6)							
Plutonium (total)(pCi/l)	R									
Plutonium 238+239+240 (pCi/l)	R									
Radium 226+228 (pCi/l)	R	(10)	5 (a)(4)							
Strontium 89+90 (pCi/l)	R		(a)(4)(6)							
Strontium 90 (pCi/l)	R		8 (a)(6)							

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							Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Thorium 230+232 (pCi/l)	R		(a)(4)							
Tritium (pCi/l)	R		20,000 (a)(4)(6)							
Uranium 233+234 (pCi/l)	R									
Uranium 235 (pCi/l)	R									
Uranium 238 (pCi/l)	R									
Uranium (total) (pCi/l)	R									
1,2,4,5-Tetrachlorobenzene	SV	(8B)							38	48
1,2,4-Trichlorobenzene	SV	(8)	70 (h)		70 (h)					
1,2-Dichlorobenzene (Ortho)	SV	(8)		600 (b)		600 (b)				
1,2-Diphenylhydrazine	SV	(8B)					270 (1)		0.042	0.56
1,3-Dichlorobenzene (Meta)	SV	(8)								
1,4-Dichlorobenzene (Para)	SV	(8)	75 (a)		75 (a)					
2,4,5-Trichlorophenol	SV	(8)							2,600	
2,4,6-Trichlorophenol	SV	(8)						970 (1)	1.2 **	3.6 **
2,4-Dichlorophenol	SV	(8)					2,020 (1)	365 (1)	3,090	
2,4-Dimethylphenol	SV	(8)					2,120 (1)			
2,4-Dinitrophenol	SV	(8)								
2,4-Dinitrotoluene	SV	(8)					330(1)	230(1)	0.11 **	9.1 **
2,6-Dinitrotoluene	SV	(8)					330 (1)	230 (1)	70	14,300
2-Chloronaphthalene	SV	(8)								
2-Chlorophenol	SV	(8)					4,380 (1)	2,000 (1)		
2-Methylnaphthalene	SV	(8)								
2-Methylphenol	SV	(8)								
2-Nitroaniline	SV	(8)								
2-Nitrophenol	SV	(8)					230(1)	150(1)		
3,3'-Dichlorobenzidine	SV	(8)							0.01	0.02
3-Nitroaniline	SV	(8)								
4,6-Dinitro-2-methylphenol	SV	(8)							13.4	765
4-Bromophenyl-phenyl-ether	SV	(8)								
4-Chloroaniline	SV	(8)								
4-Chlorophenyl-phenyl-ether	SV	(8)								
4-Chloro-3-methylphenol	SV	(8)					30 (1)			
4-Methylphenol	SV	(8)								
4-Nitroaniline	SV	(8)								
4-Nitrophenol	SV	(8)					230 (1)	150 (1)		
Acenaphthene	SV	(8)					1,700 (1)	520 (1)		
Anthracene	SV	(8)								
Benzidine	SV	(8B,C)					2,500		0.00012	0.00053
Benzoic Acid	SV	(8)								
Benzo(a)anthracene	SV	(8)								
Benzo(a)pyrene	SV	(8)	0.2 (h)		0 (h)					
Benzo(b)fluoranthene	SV	(8)								
Benzo(g,h,i)perylene	SV	(8)								

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							Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Benzo(k)fluoranthene	SV	(8)								
Benzyl Alcohol	SV	(8)								
bis(2-Chloroethoxy)methane	SV	(8)								
bis(2-Chloroethyl)ether	SV	(8)							0.03**	1.36 **
bis(Chloromethyl)ether	SV								0.00376	0.00184
bis(2-Chloroisopropyl)ether	SV	(8)							34.7	4,360
bis(2-Ethylhexyl)phthalate (Di(2-ethylhexyl)pht	SV	(8)	6 (h)		0 (h)					
Butadiene	SV									
Butylbenzylphthalate	SV	(8)								
Chlorinated Ethers	SV	(8)								
Chlorinated Napthalenes	SV	(8)					1,600 (1)			
Chloroalkylethers	SV	(8)					238,000 (1)			
Chlorophenol (Total)	SV	(8)								
Chrysene	SV	(8)								
Dibenzofuran	SV	(8)								
Dibenz(a,h)anthracene	SV	(8)								
Dichlorobenzenes	SV	(8)					1,120 (1)	763 (1)	400	2,600
Dichlorobenzidine (Total)	SV	(8)							0.01	0.02
Diethylphthalate	SV	(8)							350,000	1,800,000
Di(2-ethylhexyl)adipate	SV	(8)	400 (h)		400 (h)					
Dimethylphthalate	SV	(8)							313,000	2,900,000
Di-n-butylphthalate	SV	(8)							35,000	154,000
Di-n-octylphthalate	SV	(8)								
Ethylene Glycol	SV	(8C)								
Fluoranthene	SV	(8)					3,980 (1)		42	54
Fluorene	SV	(8)								
Formaldehyde	SV									
Haloethers	SV	(8)					360 (1)	122 (1)		
Hexachlorobenzene	SV	(8)	1 (h)		0 (h)				0.00072**	0.00074**
Hexachlorobutadiene	SV	(8)					90 (1)	9.3 (1)	0.45**	50 **
Hexachlorocyclopentadiene	SV	(8)	50 (h)		50 (h)		7 (1)	5.2 (1)	206	
Hexachloroethane	SV	(8)					980 (1)	540 (1)	1.9	8.74
Hydrazine	SV									
Indeno(1,2,3-cd)pyrene	SV	(8)								
Isophorone	SV	(8)					117,000 (1)		5,200	520,000
Naphthalene	SV	(8)					2,300 (1)	620 (1)		
Nitrobenzene	SV	(8)					27,000 (1)		19,800	
Nitrophenols	SV	(8)					230 (1)	150 (1)		
Nitrosamines	SV	(8)					5,850 (1)			
N-Nitrosodibutylamine	SV	(8B)							0.0064	0.587
N-Nitrosodiethylamine	SV	(8B)							0.0008	1.24
N-Nitrosodimethylamine	SV	(8B)							0.0014	16
N-Nitrosopyrrolidine	SV	(8B)							0.016	91.9
N-Nitrosodiphenylamine	SV	(8B)							4.9 **	16.1 **

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N-Nitroso-di-n-propylamine	SV	(8B)								
Pentachlorinated Ethanes	SV	(8B)					7,240 (1)	1,100 (1)		
Pentachlorobenzene	SV	(8B)							74	85
Pentachlorophenol	SV	(8)		1 (e)		0 (e)	20 ***	13 ***	1,010	
Phenanthrene	SV	(8)								
Phenol	SV	(8)					10,200 (1)	2,560 (1)	3,500	
Phthalate Esters	SV	(8)					940 (1)	3 (1)		
Polynuclear Aromatic Hydrocarbons	SV	(8)							0.0028**	0.0311**
Pyrene	SV	(8)								
Vinyl Chloride	V	(8)	2 (a)		0 (a)				2 **	525 **
1,1,1-Trichloroethane	V	(8)	200 (a)		200 (a)				18,400	1,030,000
1,1,2,2-Tetrachloroethane	V	(8)						2,400	0.17**	10.7 **
1,1,2-Trichloroethane	V	(8)	5 (h)		3 (h)			9,400	0.6**	41.8 **
1,1-Dichloroethane	V	(8)								
1,1-Dichloroethene	V	(8)	7 (a)		7 (a)					
1,2-Dichloroethane	V	(8)	5 (a)		0 (a)		118,000	20,000	0.94**	243 **
1,2-Dichloroethene (cis)	V	(8)		70 (b)		70 (b)				
1,2-Dichloroethene (total)	V	(8)								
1,2-Dichloroethene (trans)	V	(8)		100 (b)		100 (b)				
1,2-Dichloropropane	V	(8)		5 (b)		0 (b)	23,000	5,700		
1,3-Dichloropropene (cis)	V	(8)					6,060	244 (1)	87	14,100
1,3-Dichloropropene (trans)	V	(8)					6,060	244 (1)	87	14,100
2-Butanone	V	(8)								
2-Hexanone	V	(8)								
4-Methyl-2-pentanone	V	(8)								
Acetone	V	(8)								
Acrylonitrile	V	(8)					7,550	2,600	0.058	0.65
Benzene	V	(8)	5 (a)		0 (a)		5,300		0.66**	40 **
Bromodichloromethane	V	(8)	<100 (2)(a)							
Bromoform	V	(8)	<100 (2)(a)							
Bromomethane	V	(8)								
Carbon Disulfide	V	(8)								
Carbon Tetrachloride	V	(8)	5 (a)		0 (a)		35,200 (1)		0.4**	6.94 **
Chlorinated Benzenes	V/SV	(8)					250 (1)	50 (1)		
Chlorobenzene	V	(8)		100 (b)		100 (b)			488	
Chloroethane	V	(8)								
Chloroform	V	(8)	<100 (2)(a)				28,900 (1)	1,240 (1)	0.19 **	15.7 **
Chloromethane	V	(8)								
Dibromochloromethane	V	(8)	<100 (2)(a)							
Dichloroethenes	V	(8)					11,600 (1)		0.033**	1.85 **
Ethylbenzene	V	(8)		700 (b)		700 (b)	32,000 (1)		1,400	3,280
Ethylene Dibromide	V	(8C)		0.05 (b)		0 (b)				
Ethylene Oxide	V									

TABLE B - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	Type (7)	Method (8)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
							Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Halomethanes	V	(8)	100 (a)				11,000 (1)		0.19**	15.7 **
Methylene Chloride	V	(8)	5 (h)		0 (h)					
Styrene	V	(8)		100 (b)		100 (b)				
Tetrachloroethanes	V	(8)					9,320 (1)			
Tetrachloroethene	V	(8)		5 (b)		0 (b)	5,280 (1)	840 (1)	0.80**	8.85 **
Toluene	V	(8)		1,000 (b)		1,000 (b)	17,500 (1)		14,300	424,000
Trichloroethanes	V	(8)					18,000 (1)			
Trichloroethene	V	(8)	5 (a)		0 (a)		45,000 (1)	21,900 (1)	2.7 **	80.7 **
Vinyl Acetate	V	(8)								
Xylenes (total)	V	(8)		10,000 (b)		10,000 (b)				

EXPLANATION OF TABLE AND END NOTES

* = secondary maximum contaminant level, TBCs
** = Human health criteria for carcinogens reported for three risk levels. Value presented is the 10-5 risk level.
*** = Concentration is pH dependent

ARAR = Applicable or Relavent and Appropriate Requirement
AWQC = Ambient Water Quality Criteria
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
CWA = Clean Water Act
EPA = Environmental Protection Agency
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
SDWA = Safe Drinking Water Act
SS = Species Specific
SW = Solid Waste
TIC = Tentatively Identified Compound
ug/l = micrograms per liter
MF/L = million fibers/liter

(1) Criteria not developed; value presented is lowest observed effects level (LOEL)
(2) Total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
(3) Hardness dependent criteria, calculated assuming 50mg/l calcium carbonate
(4) Average annual concentration of beta particles and photon radioactivity cannot exceed 4 millirem/year dose equivalent.
(5) Standard is not adequately protective when chloride is associated with potassium, calcium, or magnesium, rather than sodium.
(6) If both strontium-90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 mrem/yr.
(7) Type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; H=herbicide; IN=inorganic; FP=field parameter; M=metal; P=pesticide; PP=pesticide/PCB;
R=radionuclide; SV=semi-volatile; V=volatile
(8) See Attachment 1 for analytical methods with corresponding detection limits
abbreviations are: E=EPA; SW=SW846; A = detected as total; B = detected as TICs or with method modifications; C = not routinely monitored; D = monitored in discharge ponds; E = mixture-individual isomers detected
(9) Value for gross alpha excludes uranium
(10) MDL for radium 226 is 0.5; MDL for radium 228 is 1.0

TABLE B - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	Type (7)	Method (8)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
							Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only

(11) Where the standard is below (more stringent than) the PQL, the PQL is interpreted to be the compliance level.

(a) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of May 1990). Segment 4 MCLs are ARAR; Segment 5 MCLs are TBC; all MCLGs are TBC.
(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142 and 143, Final Rule, effective July 30, 1992 (56 Federal Register 3526; 1/30/1991).
(c) EPA, Quality Criteria for Protection of Aquatic Life, 1986
(d) EPA, National Ambient Water Quality Criteria for Selenium - 1987
(e) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, and 143, Final Rule (56 FR 30266; 7/1/1991) effective 1/1/1993.
(f) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142 (56 FR 26460; 6/7/1991) effective 12/7/92 and 11/6/91. Action levels effective 12/7/92; MCLGs effective 11/6/91. Action level in 10% or less of tap samples for small and medium-sized systems.
(g) EPA, National Ambient Water Quality Criteria for Chloride - 1988
(h) EPA National Primary Drinking Water Regulations, 40 CFR 141 and 142, Final Rule, Effective January 17, 1994
(i) EPA National Primary Drinking Water Regulations, 40 CFR 141, Postponement of Final Rule and Reconsideration (57 FR 22178) - no effective date established.

TABLE C - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Statewide Standards (a)								Basin Standards (b)	
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life (11)				Organics (7)	
Parameter	Type (5)	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,12)	Domestic Water Supply (4,12)	Aquatic Life	Water Supply
Chloride	A	E325								250,000		
Cyanide (Free)	A	E335					5		200	200		
Fluoride	A	E340								2,000		
N as Nitrate	A	E353.1							100,000	10,000		
N as Nitrate+Nitrite	A	E353.1							100,000	10,000		
N as Nitrite	A	E354.1					SS	SS	10,000	1,000		
Sulfate	A	E375.4								250,000		
Sulfide, H2S Undissociated	A	E376.1						2		50		
Coliform (Fecal)	B	SM9221C								2000/100 ml		
Ammonia, Total	C	E350					TVS	60		500		
Dioxin	D	(6)	0.00000022	0.000000013	0.01	0.00001						
Boron	E	SW6010(6B)							750			
Chlorine, Total Residual	E	SM4500					19	11				
Sulfur	E											
Dissolved Oxygen	FP	SM4500					>5,000	>5,000	>3,000	>3,000		
pH (Standard Units)	FP	E150.1					6.5-9.0	6.5-9.0		5.0-9.0		
Specific Conductance	FP	E120.1										
Temperature (Degrees Celsius)	FP						30 degrees	30 degrees				
Alkalinity	IN	E310.1										
Asbestos	IN											
Total Dissolved Solids	IN	E160.1										
Total Organic Carbon	IN	E415.1										
Aluminum	M	(6)					750	87				
Antimony	M	(6)								14		
Arsenic	M	(6)					360	150	100	50		
Arsenic III	M											
Arsenic V	M											
Barium	M	(6)								1,000		
Beryllium	M	(6)							100	0.0076		
Cadmium	M	(6)					TVS	TVS	10	10		
Calcium	M	(6)										
Cesium	M	(6)										
Chromium	M	(6)										
Chromium III	M						TVS	TVS	100	50		
Chromium VI	M	E218.5					16	11	100	50		
Cobalt	M	(6)										
Copper	M	(6)					TVS	TVS	200	1,000		
Iron	M	(6)						1,000 (Trec)		300 (dis)		
Lead	M	(6)					TVS	TVS	100	50		
Lithium	M	(6)										
Magnesium	M	(6)										
Manganese	M	(6)						1,000	200	50 (dis)		
Mercury	M	(6)					2.4	0.1		2.0		
Molybdenum	M	(6)										
Nickel	M	(6)					TVS	TVS	200			
Potassium	M	(6)										
Selenium	M	(6)					135	17	20	10		
Silver	M	(6)					TVS	TVS		50		

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			Statewide Standards (a)								Basin Standards (b)	
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life (11)				Organics (7)	
Parameter	Type (5)	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,12)	Domestic Water Supply (4,12)	Aquatic Life	Water Supply
Sodium	M	(6)										
Strontium	M	(6)										
Thallium	M	(6)						15		0.012		
Tin	M	(6)										
Titanium	M	SW6010 (6B)										
Tungsten	M	SW6010 (6B)										
Vanadium	M	(6)										
Zinc	M	(6)					TVS	TVS	2,000	5,000		
Aldicarb	P		10									
Aldicarb Sulfone	P											
Aldicarb Sulfoxide	P											
Aldrin	P	(6)	0.002 (8)	0.00013	1.5						<0.003	
Aldrin & Dieldrin combined	P	(6)									<0.003	
Carbofuran	P	(6C)	36									
Chloranil	P											
Chlordane	P	(6)	0.03 (8)		1.2	0.0043						
Chlorpyifos	P	(6)			0.083	0.041						
DDT	P	(6)	0.1	0.00059	0.55	0.001					0.001	
DDT Metabolite (DDD)	P	(6)		0.00083	0.6						0.001	
DDT Metabolite (DDE)	P	(6)	0.1	0.00059	1,050						0.001	
Demeton	P	(6)				0.1					0.1	
Diazinon	P	(6)										
Dieldrin	P	(6)	0.002	0.00014	1.3	0.0019					<0.003	
Endosulfan I	P	(6)		0.93	0.11	0.056					0.003	
Endosulfan II	P	(6)										
Endosulfan Sulfate	P	(6)		0.93								
Endrin	P	(6)	0.2		0.09	0.0023					0.004	
Endrin Aldehyde	P	(6B)	0.2	0.2								
Endrin Ketone	P	(6B)										
Guthion (Azinphos methyl)	P	(6)				0.01					0.01	
Heptachlor	P	(6)	0.008	0.00021	0.26	0.0038					0.001	0.2
Heptachlor Epoxide	P	(6)	0.09	0.0001	0.26	0.0038						
Hexachlorocyclohexane, Alpha	P	(6)	0.006		0.0039							
Hexachlorocyclohexane, Beta	P	(6)		0.014								
Hexachlorocyclohexane (HCH or BHC)	P				100							
Hexachlorocyclohexane, Delta	P	(6)										
Hexachlorocyclohexane, Technical (Total)	P	(6E)		0.012								
Hexachlorocyclohexane, Gamma (Lindane)	P	(6)	0.2	0.019	1.0	0.08					0.01	4
Malathion	P	(6B)				0.1					0.1	
Methoxychlor	P	(6)	40			0.03					0.03	100
Mirex	P					0.001					0.001	
Oxamyl (Vydate)	P											
Parathion	P	(6B)									0.04	100
Toxaphene	P	(6)	0.03	0.00073	0.73	0.0002					0.005	5
Vaponite 2	P											
Aroclor 1016	PP	(6)										
Aroclor 1221	PP	(6)										
Aroclor 1232	PP	(6)										
Aroclor 1242	PP	(6)										
Aroclor 1248	PP	(6)										
Aroclor 1254	PP	(6)										

TABLE C - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Statewide Standards (a)								Basin Standards (b)	
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1) Aquatic Life (11)				Organics (7)	
Parameter	Type (5)	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,12)	Domestic Water Supply (4,12)	Aquatic Life	Water Supply
Arocior 1260	PP	(6)										
PCBs (Total)	PP	(6)	0.005	0.000044	2.0	0.014					0.001	
2,4,5-TP Silvex	H	(6C)	50									
2,4-D	H	(6C)	70									100
Acrolein	H			320	68	21						
Atrazine	H	(6D)										
Bromacil	H											
Dalapon	H	(6)										
Dinoseb	H	(6)										
Diquat	H											
Endothall	H											
Glyphosate	H											
Picloram	H											
Simazine	H	(6D)										
Americium (Total)(pCi/l)	R											
Americium 241 (pCi/l)	R											
Cesium 134 (pCi/l)	R		80 (10)									
Cesium 137 (pCi/l)	R											
Gross Alpha (pCi/l)	R											
Gross Beta (pCi/l)	R											
Plutonium (Total)(pCi/l)	R											
Plutonium 238+239+240 (pCi/l)	R		15 (10)									
Radium 226+228 (pCi/l)	R	(9)	5 (10)									
Strontium 89+90 (pCi/l)	R											
Strontium 90 (pCi/l)	R		8 (10)									
Thorium 230+232 (pCi/l)	R		60 (10)									
Tritium (pCi/l)	R		20,000 (10)									
Uranium 233+234 (pCi/l)	R											
Uranium 235 (pCi/l)	R											
Uranium 238 (pCi/l)	R											
Uranium (Total) (pCi/l)	R						TVS	TVS				
1,2,4,5-Tetrachlorobenzene	SV	(6B)	2 (8)									
1,2,4-Trichlorobenzene	SV	(6)										
1,2-Dichlorobenzene (Ortho)	SV	(6)	620	620								
1,2-Diphenylhydrazine	SV	(6B)	0.05	0.04	270							
1,3-Dichlorobenzene (Meta)	SV	(6)	620	400								
1,4-Dichlorobenzene (Para)	SV	(6)	75	75								
2,4,5-Trichlorophenol	SV	(6)										
2,4,6-Trichlorophenol	SV	(6)	2	2		970						
2,4-Dichlorophenol	SV	(6)	21	21	2,020	365						
2,4-Dimethylphenol	SV	(6)			2,120							
2,4-Dinitrophenol	SV	(6)	14	14								
2,4-Dinitrotoluene	SV	(6)		0.11								
2,6-Dinitrotoluene	SV	(6)			330	230						
2-Chloronaphthalene	SV	(6)										
2-Chlorophenol	SV	(6)			4,380	2,000						
2-Methylnaphthalene	SV	(6)										
2-Methylphenol	SV	(6)										
2-Nitroaniline	SV	(6)										
2-Nitrophenol	SV	(6)										

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			Statewide Standards (a)									Basin Standards (b)	
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (6)		Tables I,II,III (1) Aquatic Life (11)				Organics (7)	
Parameter	Type (5)	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,12)	Domestic Water Supply (4,12)	Aquatic Life	Water Supply
Dichlorobenzidine (Total)	SV	(6)		0.039								
3-Nitroaniline	SV	(6)										
4,6-Dinitro-2-methylphenol	SV	(6)		13								
4-Bromophenyl-phenyl-ether	SV	(6)										
4-Chloroaniline	SV	(6)										
4-Chlorophenyl-phenyl-ether	SV	(6)										
4-Chloro-3-methylphenol	SV	(6)			30							
4-Methylphenol	SV	(6)										
4-Nitroaniline	SV	(6)										
4-Nitrophenol	SV	(6)										
Acenaphthene	SV	(6)			1,700	520						
Anthracene	SV	(6)		0.0028								
Benzidine	SV	(6B,C)	0.0002	0.00012(8)	2,500						0.1	0.01
Benzoic Acid	SV	(6)										
Benzo(a)anthracene	SV	(6)		0.0028								
Benzo(a)pyrene	SV	(6)		0.0028								
Benzo(b)fluoranthene	SV	(6)		0.0028								
Benzo(g,h,i)perylene	SV	(6)		0.0028								
Benzo(k)fluoranthene	SV	(6)		0.0028								
Benzyl Alcohol	SV	(6)										
bis(2-Chloroethoxy)methane	SV	(6)										
bis(2-Chloroethyl)ether	SV	(6)	0.03 (8)	0.03 (8)								
bis(2-Chloroisopropyl)ether	SV	(6)		1,400								
bis(2-Ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	SV	(6)		1.8 (8)								
Butadiene	SV											
Butylbenzylphthalate	SV	(6)		3,000								
Chlorinated Ethers	SV	(6)										
Chlorinated Napthalenes	SV	(6)										
Chloroalkylethers	SV	(6)										
Chlorophenol (Total)	SV	(6)									1	1
Chrysene	SV	(6)		0.0028								
Dibenzofuran	SV	(6)										
Dibenz(a,h)anthracene	SV	(6)		0.0028								
Dichlorobenzenes	SV	(6)										
Diethylphthalate	SV	(6)		23,000								
Di(2-ethylhexyl)adipate	SV	(6)										
Dimethylphthalate	SV	(6)		313,000								
Di-n-butylphthalate	SV	(6)		2,700								
Di-n-octylphthalate	SV	(6)										
Ethylene Glycol	SV	(6C)										
Fluoranthene	SV	(6)		42	3,980							
Fluorene	SV	(6)		0.0028								
Formaldehyde	SV											
Haloethers	SV	(6)										
Hexachlorobenzene	SV	(6)	6	0.00072								
Hexachlorobutadiene	SV	(6)	1	0.45	90	9.3						
Hexachlorocyclopentadiene	SV	(6)		240	7	5						
Hexachloroethane	SV	(6)		1.9	980	540						
Hydrazine	SV											
Indeno(1,2,3-cd)pyrene	SV	(6)		0.0028								
Isophorone	SV	(6)	1,050	8.4	117,000							
Naphthalene	SV	(6)		0.0028	2,300	620						
Nitrobenzene	SV	(6)	3.5	3.5	27,000							

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			Statewide Standards (a)								Basin Standards (b)	
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)				Organics (7)	
							Aquatic Life (11)					
Parameter	Type (5)	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,12)	Domestic Water Supply (4,12)	Aquatic Life	Water Supply
Nitrophenols	SV	(6)										
Nitrosamines	SV	(6)										
N-Nitrosodibutylamine	SV	(6B)		0.0064								
N-Nitrosodiethylamine	SV	(6B)		0.0008								
N-Nitrosodimethylamine	SV	(6B)		0.00069								
N-Nitrosopyrrolidine	SV	(6B)		0.016								
N-Nitrosodiphenylamine	SV	(6B)		4.9								
N-Nitroso-di-n-propylamine	SV	(6B)		0.005								
Pentachlorinated Ethanes	SV	(6B)										
Pentachlorobenzene	SV	(6B)	6 (8)									
Pentachlorophenol	SV	(6)	200		9	5.7						
Phenanthrene	SV	(6)		0.0028								
Phenol	SV	(6)		21,000	10,200	2,560					500	1
Phthalate Esters	SV	(6)										
Polynuclear Aromatic Hydrocarbons	SV	(6)		0.0028								
Pyrene	SV	(6)		0.0028								
Vinyl Chloride	V	(6)	2	2								
1,1,1-Trichloroethane	V	(6)	200	200								
1,1,2,2-Tetrachloroethane	V	(6)		0.17		2,400						
1,1,2-Trichloroethane	V	(6)	3	0.6	9,400							
1,1-Dichloroethane	V	(6)										
1,1-Dichloroethene	V	(6)	7	0.057								
1,2-Dichloroethane	V	(6)	0.4	0.4	118,000	20,000						
1,2-Dichloroethene (cis)	V	(6)	70									
1,2-Dichloroethene (total)	V	(6)										
1,2-Dichloroethene (trans)	V	(6)	100									
1,2-Dichloropropane	V	(6)	0.56 (8)	0.56	23,000	5,700						
1,3-Dichloropropene (cis)	V	(6)		10	6,060	244						
1,3-Dichloropropene (trans)	V	(6)		10	6,060	244						
2-Butanone	V	(6)										
2-Hexanone	V	(6)										
4-Methyl-2-pentanone	V	(6)										
Acetone	V	(6)										
Acrylonitrile	V	(6)		0.058	7,500	2,600						
Benzene	V	(6)	1	1	5,300							
Bromodichloromethane	V	(6)	0.3	0.3								
Bromoform	V	(6)	4	4								
Bromomethane	V	(6)		48								
Carbon Disulfide	V	(6)										
Carbon Tetrachloride	V	(6)	0.3	0.25	35,200							
Chlorinated Benzenes	V/SV	(6)										
Chlorobenzene	V	(6)	100	100								
Chloroethane	V	(6)										
Chloroform	V	(6)	6	6	28,900	1,240						
Chloromethane	V	(6)		5.7								
Dibromochloromethane	V	(6)	14	6								
Dichloroethenes	V	(6)										
Ethylbenzene	V	(6)	680	3,100	32,000							
Ethylene Dibromide	V	(6C)										
Ethylene Oxide	V											
Halomethanes	V	(6)										
Methylene Chloride	V	(6)		4.7								

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			Statewide Standards (a)								Basin Standards (b)	
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)				Organics (7)	
							Aquatic Life (11)					
Parameter	Type (5)	Method (6)	Water Supply	Water and Fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,12)	Domestic Water Supply (4,12)	Aquatic Life	Water Supply
Styrene	V	(6)										
Tetrachloroethanes	V	(6)										
Tetrachloroethene	V	(6)	5	0.8	5,280	840						
Toluene	V	(6)	1,000	1,000	17,500							
Trichloroethanes	V	(6)										
Trichloroethene	V	(6)	5	2.7	45,000	21,900						
Vinyl Acetate	V	(6)										
Xylenes (Total)	V	(6)										

EXPLANATION OF TABLE

ARAR	= Applicable or Relevant and Appropriate Requirements
CDH	= Colorado Department of Health
dis	= dissolved
EPA	= Environmental Protection Agency
pCi/l	= picocuries per liter
PCB	= polychlorinated biphenyl
SS	= species specific
SW	= Solid Waste
TIC	= Tentatively Identified Compound
Trec	= Total recoverable
TVS	= Table Value Standard (hardness dependent), see Table III in (a)
ug/l	= micrograms per liter
WQCC	= Water Quality Control Commission

(1) Table I = physical and biological parameters
Table II = inorganic parameters
Table III = metal parameters
Values in Tables I, II, and III for recreational uses and cold water biota are not included.
(2) N/A - Endnote deleted.

(3) All are 30-day values except for nitrate, nitrite, and cyanide.
(4) Ammonia, sulfide, chloride, sulfate, copper, iron, manganese, antimony, beryllium, selenium, thallium, and zinc are 30-day standards, all others are 1-day standards
(5) type abbreviations are: A=anion; B=bacteria; C=cation; IN=inorganic; FP=field parameter; H=herbicide; M=metal; P= pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile
(6) See Attachment 1 for analytical methods and corresponding detection limits
abbreviations are: E=EPA; SW=SW846; a=detected as total; b=detected as TICs or with method modifications; c=not routinely monitored; d=monitored in discharge ponds; e=mixture-individual isomers detected
(7) Basic Standards for Organic Chemicals (reference a) apply as stream standards where none are listed in Table 1A (reference b). See section 3.8.5(2)(f).
In the absence of specific numeric standards for non-naturally occurring organics, the narrative standard "free from toxics" (section 3.1.11(1)(d)) shall be interpreted and applied in accordance with the provisions of section 3.12.7(1)(c)(iv), so that

(8) Where the standard is below (more stringent than) the PQL, the PQL is interpreted to be the compliance level.
(9) MDL for Radium 226 is 0.5; MDL for Radium 228 is 1.0
(10) These parameters are to be maintained at the lowest practical level; See section 3.1.11(2) in (a)
(11) Metals for aquatic life use are stated as dissolved unless otherwise specified.
(12) Metals for agricultural and domestic use are stated as total recoverable unless otherwise specified.

(a) CDH/WQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8) 1/15/1974; amended 10/8/1991.
(b) CDH/WQCC, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin 3.8.0 (5 CCR 1002-8) 4/6/1981; amended 2/1/93.

TABLE D - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	Type (4)	Method (3)	Segment 4 & 5 Stream Classification and Water Quality Standards (b) (2) — Stream Segment Table (7) Acute Value	Stream Segment Table (7) Chronic Value	Table 2 Radionuclides (6) Woman Creek	Table 2 Radionuclides (6) Walnut Creek
Chloride	A	E325		250,000		
Cyanide (Free)	A	E335		5		
Fluoride	A	E340				
N as Nitrate	A	E353.1		10,000		
N as Nitrate+Nitrite	A	E353.1				
N as Nitrite	A	E354.1		500		
Sulfate	A	E375.4		250,000		
Sulfide, H2S Undissociated	A	E376.1		2		
Coliform (Fecal)	B	SM9221C		2,000/100ml		
Ammonia as N	C	E350	TVS	100		
Dioxin	D	(3)		0.00000001		
Boron	E	SW6010(3B)		750		
Chlorine, Total Residual	E	SM4500	19	11		
Sulfur	E			2		
Dissolved Oxygen	FP	SM4500	>5,000	>5,000		
pH (Standard Units)	FP	E150.1	6.5-9	6.5-9		
Specific Conductance	FP	E120.1				
Temperature (Degrees Celsius)	FP					
Alkalinity	IN	E310.1				
Asbestos	IN					
Total Dissolved Solids	IN	E160.1				
Total Organic Carbon	IN	E415.1				
Aluminum	M	(3)				
Antimony	M	(3)				
Arsenic (Total Recoverable)	M	(3)	50			
Arsenic III	M					
Arsenic V	M					
Barium	M	(3)				
Beryllium	M	(3)	4			
Cadmium	M	(3)	TVS	TVS		
Calcium	M	(3)				
Cesium	M	(3)				
Chromium	M	(3)				
Chromium III (Total Recoverable)	M		50			

TABLE D - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	Type (4)	Method (3)	Segment 4 & 5 Stream Classification and Water Quality Standards (b) (2)			
			Stream Segment Table (7)		Table 2 Radionuclides (6)	
			Acute Value	Chronic Value	Woman Creek	Walnut Creek
Chromium VI	M	E218.5	16	11		
Cobalt	M	(3)				
Copper	M	(3)	TVS	TVS		
Iron (Dissolved)	M	(3)	300	50		
Iron (Trec)	M	(3)	1,000	1,000		
Lead	M	(3)	TVS	TVS		
Lithium	M	(3)				
Magnesium	M	(3)				
Manganese (Dissolved)	M	(3)	300	50		
Manganese (Trec)	M	(3)	1,000	1,000		
Mercury	M	(3)		0.01 (Total)		
Molybdenum	M	(3)				
Nickel	M	(3)	TVS	TVS		
Potassium	M	(3)				
Selenium (Total Recoverable)	M	(3)	10			
Silver	M	(3)	TVS	TVS		
Sodium	M	(3)				
Strontium	M	(3)				
Thallium	M	(3)				
Tin	M	(3)				
Titanium	M	SW6010(3B)				
Tungsten	M	SW6010(3B)				
Vanadium	M	(3)				
Zinc	M	(3)	TVS	TVS		
Aldicarb	P					
Aldicarb Sulfone	P					
Aldicarb Sulfoxide	P					
Aldrin	P	(3)		0.000074		
Carbofuran	P	(3C)				
Chloranil	P					
Chlordane	P	(3)		0.00046		
Chlorpyifos	P	(3)				
DDT	P	(3)		0.000024		
DDT Metabolite (DDD)	P	(3)				
DDT Metabolite (DDE)	P	(3)				
Demeton	P	(3)				
Diazinon	P	(3)				
Dieldrin	P	(3)		0.000071		
Endosulfan I	P	(3)				

TABLE D - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Segment 4 & 5 Stream Classification and Water Quality Standards (b) (2)			
			Stream Segment Table (7)		Table 2 Radionuclides (6)	
Parameter	Type (4)	Method (3)	Acute Value	Chronic Value	Woman Creek	Walnut Creek
Endosulfan II	P	(3)				
Endosulfan Sulfate	P	(3)				
Endrin	P	(3)				
Endrin Aldehyde	P	(3B)				
Endrin Ketone	P	(3B)				
Guthion (Azinphos methyl)	P	(3)				
Heptachlor	P	(3)		0.00028		
Heptachlor Epoxide	P	(3)				
Hexachlorocyclohexane, Alpha	P	(3)		0.0092		
Hexachlorocyclohexane, Beta	P	(3)		0.0163		
Hexachlorocyclohexane (HCH or BH	P					
Hexachlorocyclohexane, Delta	P	(3)				
Hexachlorocyclohexane, Technical (T	P	(3E)		0.0123		
Hexachlorocyclohexane, Gamma (Lin	P	(3)		0.0186		
Malathion	P	(3B)				
Methoxychlor	P	(3)				
Mirex	P					
Oxamyl (Vydate)	P					
Parathion	P	(3B)				
Toxaphene	P	(3)				
Vaponite 2	P					
Aroclor 1016	PP	(3)				
Aroclor 1221	PP	(3)				
Aroclor 1232	PP	(3)				
Aroclor 1242	PP	(3)				
Aroclor 1248	PP	(3)				
Aroclor 1254	PP	(3)				
Aroclor 1260	PP	(3)				
PCBs (Total)	PP	(3)		0.000079		
2,4,5-TP Silvex	H	(3C)				
2,4-Dichlorophenoxyacetic Acid (2,4-	H	(3C)				
Acrolein	H					
Atrazine	H	(3D)		3		
Bromacil	H					
Dalapon	H	(3)				
Dinoseb	H	(3)				
Diquat	H					
Endothall	H					

TABLE D - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Segment 4 & 5 Stream Classification and Water Quality Standards (b) (2)			
			Stream Segment Table (7)		Table 2 Radionuclides (6)	
Parameter	Type (4)	Method (3)	Acute Value	Chronic Value	Woman Creek	Walnut Creek
Glyphosate	H					
Picloram	H					
Simazine	H	(3D)		4		
Americium (Total) (pCi/l)	R				0.05	0.05
Americium 241 (pCi/l)	R					
Cesium 134 (pCi/l)	R				80	80
Cesium 137 (pCi/l)	R					
Gross Alpha (pCi/l)	R				7	11
Gross Beta (pCi/l)	R				5	19
Plutonium (Total) (pCi/l)	R				0.05	0.05
Plutonium 238+239+240 (pCi/l)	R				15(a)	15(a)
Radium 226+228 (pCi/l)	R	(5)			5(a)	5(a)
Strontium 89+90 (pCi/l)	R					
Strontium 90 (pCi/l)	R				8	8
Thorium 230+232 (pCi/l)	R				60(a)	60(a)
Tritium (pCi/l)	R				500	500
Uranium 233+234 (pCi/l)	R					
Uranium 235 (pCi/l)	R					
Uranium 238 (pCi/l)	R					
Uranium (Total) (pCi/l)	R				5	10
1,2,4,5-Tetrachlorobenzene	SV	(3B)				
1,2,4-Trichlorobenzene	SV	(3)				
1,2-Dichlorobenzene (Ortho)	SV	(3)				
1,2-Diphenylhydrazine	SV	(3B)				
1,3-Dichlorobenzene (Meta)	SV	(3)				
1,4-Dichlorobenzene (Para)	SV	(3)				
2,4,5-Trichlorophenol	SV	(3)				
2,4,6-Trichlorophenol	SV	(3)		1.2		
2,4-Dichlorophenol	SV	(3)				
2,4-Dimethylphenol	SV	(3)				
2,4-Dinitrophenol	SV	(3)				
2,4-Dinitrotoluene	SV	(3)				
2,6-Dinitrotoluene	SV	(3)				
2-Chloronaphthalene	SV	(3)				
2-Chlorophenol	SV	(3)				
2-Methylnaphthalene	SV	(3)				
2-Methylphenol	SV	(3)				
2-Nitroaniline	SV	(3)				

TABLE D - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	Type (4)	Method (3)	Segment 4 & 5 Stream Classification and Water Quality Standards (b) (2)			
			Stream Segment Table (7)		Table 2 Radionuclides (6)	
			Acute Value	Chronic Value	Woman Creek	Walnut Creek
2-Nitrophenol	SV	(3)				
3-Nitroaniline	SV	(3)				
4,6-Dinitro-2-methylphenol	SV	(3)				
4-Bromophenyl-phenyl-ether	SV	(3)				
4-Chloroaniline	SV	(3)				
4-Chlorophenyl-phenyl-ether	SV	(3)				
4-Chloro-3-methylphenol	SV	(3)				
4-Methylphenol	SV	(3)				
4-Nitroaniline	SV	(3)				
4-Nitrophenol	SV	(3)				
Acenaphthene	SV	(3)				
Anthracene	SV	(3)				
Benzidine	SV	(3B,C)		0.00012		
Benzoic Acid	SV	(3)				
Benzo(a)anthracene	SV	(3)				
Benzo(a)pyrene	SV	(3)				
Benzo(b)fluoranthene	SV	(3)				
Benzo(g,h,l)perylene	SV	(3)				
Benzo(k)fluoranthene	SV	(3)				
Benzyl Alcohol	SV	(3)				
bis(2-Chloroethoxy)methane	SV	(3)				
bis(2-Chloroethyl)ether	SV	(3)		0.0000037		
bis(Chloromethyl)ether	SV					
bis(2-Chloroisopropyl)ether	SV	(3)				
bis(2-Ethylhexyl)phthalate (Di(2-ethyl	SV	(3)				
Butadiene	SV					
Butyl Benzylphthalate	SV	(3)				
Chlorinated Ethers	SV	(3)				
Chlorinated Napthalenes	SV	(3)				
Chloroalkylethers	SV	(3)				
Chlorophenol (total)	SV	(3)				
Chrysene	SV	(3)				
Dibenzofuran	SV	(3)				
Dibenz(a,h)anthracene	SV	(3)				
Dichlorobenzenes	SV	(3)				
Dichlorobenzidine (Total)	SV	(3)		0.01		
Diethylphthalate	SV	(3)				
Di(2-ethylhexyl)adipate	SV	(3)				
Dimethylphthalate	SV	(3)				
Di-n-butylphthalate	SV	(3)				

TABLE D - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Segment 4 & 5 Stream Classification and Water Quality Standards (b) (2)			
			Stream Segment Table (7)		Table 2 Radionuclides (6)	
Parameter	Type (4)	Method (3)	Acute Value	Chronic Value	Women Creek	Walnut Creek
Di-n-octylphthalate	SV	(3)				
Ethylene Glycol	SV	(3C)				
Fluoranthene	SV	(3)				
Fluorene	SV	(3)				
Formaldehyde	SV					
Haloethers	SV	(3)				
Hexachlorobenzene	SV	(3)		0.00072		
Hexachlorobutadiene	SV	(3)		0.45		
Hexachlorocyclopentadiene	SV	(3)				
Hexachloroethane	SV	(3)		1.9		
Hydrazine	SV					
Indeno(1,2,3-cd)pyrene	SV	(3)				
Isophorone	SV	(3)				
Naphthalene	SV	(3)				
Nitrobenzene	SV	(3)				
Nitrophenols	SV	(3)				
Nitrosamines	SV	(3)				
N-Nitrosodibutylamine	SV	(3B)		0.0064		
N-Nitrosodiethylamine	SV	(3B)		0.0008		
N-Nitrosodimethylamine	SV	(3B)		0.0014		
N-Nitrosopyrrolidine	SV	(3B)		0.016		
N-Nitrosodiphenylamine	SV	(3B)		4.9		
N-Nitroso-di-n-propylamine	SV	(3B)				
Pentachlorinated Ethanes	SV	(3B)				
Pentachlorobenzene	SV	(3B)				
Pentachlorophenol	SV	(3)				
Phenanthrene	SV	(3)				
Phenol	SV	(3)				
Phthalate Esters	SV	(3)				
Polynuclear Aromatic Hydrocarbons	SV	(3)				
Pyrene	SV	(3)				
Vinyl Chloride	V	(3)				
1,1,1-Trichloroethane	V	(3)				
1,1,2,2-Tetrachloroethane	V	(3)		0.17		
1,1,2-Trichloroethane	V	(3)		0.60		
1,1-Dichloroethane	V	(3)				
1,1-Dichloroethene	V	(3)				
1,2-Dichloroethane	V	(3)				
1,2-Dichloroethene (cis)	V	(3)				

TABLE D - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Segment 4 & 5 Stream Classification and Water Quality Standards (b) (2)			
			Stream Segment Table (7)		Table 2 Radionuclides (6)	
Parameter	Type (4)	Method (3)	Acute Value	Chronic Value	Woman Creek	Walnut Creek
1,2-Dichloroethene (total)	V	(3)				
1,2-Dichloroethene (trans)	V	(3)				
1,2-Dichloropropane	V	(3)				
1,3-Dichloropropene (cis)	V	(3)				
1,3-Dichloropropene (trans)	V	(3)				
2-Butanone	V	(3)				
2-Hexanone	V	(3)				
4-Methyl-2-pentanone	V	(3)				
Acetone	V	(3)				
Acrylonitrile	V	(3)		0.058		
Benzene	V	(3)				
Bromodichloromethane	V	(3)				
Bromoform	V	(3)				
Bromomethane	V	(3)				
Carbon Disulfide	V	(3)				
Carbon Tetrachloride	V	(3)				
Chlorinated Benzenes	V/SV	(3)				
Chlorobenzene	V	(3)				
Chloroethane	V	(3)				
Chloroform	V	(3)		0.19		
Chloromethane	V	(3)				
Dibromochloromethane	V	(3)				
Dichloroethenes	V	(3)				
Ethylbenzene	V	(3)				
Ethylene Dibromide	V	(3C)				
Ethylene Oxide	V					
Halomethanes	V	(3)		0.19		
Methylene Chloride	V	(3)				
Styrene	V	(3)				
Tetrachloroethanes	V	(3)		0.8		
1,1,2,2-Tetrachloroethene	V	(3)				
Toluene	V	(3)				
Trichloroethanes	V	(3)				
1,1,1-Trichloroethene	V	(3)				
Vinyl Acetate	V	(3)				
Xylenes (Total)	V	(3)				

EXPLANATION OF TABLE AND ENDNOTES

CDH = Colorado Department of Health

TABLE D - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
STREAM SEGMENT (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Segment 4 & 5 Stream Classification and Water Quality Standards (b) (2)			
			Stream Segment Table (7)		Table 2 Radionuclides (6)	
Parameter	Type (4)	Method (3)	Acute Value	Chronic Value	Woman Creek	Walnut Creek

EPA = Environmental Protection Agency
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
RFP = Rocky Flats Plant
SS = specific species
THM = Total Trihalomethanes: bromoform, chloroform, bromodichloromethane, dibromochloromethane
TIC = Tentatively Identified Compound
TVS = Table Value Standard (hardness dependent), see Table III in (a)
ug/l = micrograms per liter
WQCC = Water Quality Control Commission

(1) In the absence of specific, numeric standards for non-naturally occurring organics, the narrative standard is interprete practical quantification levels (PQLs) as defined by CDH/WQCC or EPA
(2) Segment 5 has a goal qualifier for all use classifications.
(3) See Attachment 1 for analytical methods with corresponding detection limits. abbreviations are: E=EPA; SW=SW846; a=detected as total; b=detected as TICs or with method modifications; c=not discharge ponds; e=mixture-individual isomers detected
(4) Type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; FP=field parameter; H=herbicide; IN=in PP=pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile
(5) MDL for Radium 226 is 0.5; MDL for Radium 228 is 1.0
(6) These parameters are to be maintained at the lowest practical level: See section 3.1.11 (f) (2) in (a)
(7) Where the standard is below (more stringent than) the PQL, the PQL is interpreted to be the compliance level.

(a) CDH/WQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8) 1/15/1974; amended 10/8/1991.
(b) CDH/WQCC, Classifications and Numeric Standards for S. Platte River Basin, Laramie River Basin, Republican Rive Smoky Hill River Basin 3.8.0 (5 CCR 1002-8) 4/6/1981; amended 7/16/1992 - Site-specific standards may become basin-wide in 1993 with modifications.

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

			FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
Parameter	Type (1)	Method (2)	SOLIDS (PPM)	LIQUIDS (mg/l)	SOLIDS (PPM)	LIQUIDS (mg/l)
Chloride	A	E325				
Cyanide (Free)	A	E335	4.416 E+0	4.416 E+0		
Fluoride	A	E340				
N as Nitrate	A	E353.1				
N as Nitrate+Nitrite	A	E353.1				
N as Nitrite	A	E354.1				
Sulfate	A	E375.4				
Sulfide, H2S Undissociated	A	E376.1				
Coliform (Fecal)	B	SM9221C				
Ammonia as N	C	E350				
Dioxin	D	(2)				
Boron	E	SW6010(2				
Chlorine, Total Residual	E	SM4500				
Sulfur	E					
Dissolved Oxygen	FP	SM4500				
pH (Standard Units)	FP	E150.1				
Specific Conductance	FP	E120.1				
Temperature (Degrees Celsius)	FP					
Alkalinity	IN	E310.1				
Asbestos	IN					
Total Dissolved Solids	IN	E160.1				
Total Organic Carbon	IN	E415.1				
Aluminum	M	(2)				
Antimony	M	(2)	6.309 E-02	6.309 E-02		
Arsenic	M	(2)	3.155 E-01	3.155 E-01		

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

			FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
Parameter	Type (1)	Method (2)	SOLIDS (PPM)	LIQUIDS (mg/l)	SOLIDS (PPM)	LIQUIDS (mg/l)
Arsenic III	M					
Arsenic V	M					
Barium	M	(2)	6.309 E+0	6.309 E+0		
Beryllium	M	(2)				
Cadmium	M	(2)	6.309 E-02	6.309 E-02		
Calcium	M	(2)				
Cesium	M	(2)				
Chromium	M	(2)	3.155 E-01	3.155 E-01		
Chromium III	M					
Chromium VI	M	E218.5				
Cobalt	M	(2)				
Copper	M	(2)				
Iron	M	(2)				
Lead	M	(2)	j	j		
Lithium	M	(2)				
Magnesium	M	(2)				
Manganese	M	(2)				
Mercury	M	(2)	1.262 E-02	1.262 E-02		
Molybdenum	M	(2)				
Nickel	M	(2)	j	j		
Potassium	M	(2)				
Selenium	M	(2)	6.309 E-02	6.309 E-02		
Silver	M	(2)	3.155 E-01	3.155 E-01		
Sodium	M	(2)				
Strontium	M	(2)				
Thallium	M	(2)	1.893 E-02	1.893 E-02		
Tin	M	(2)				
Titanium	M	SW6010(2				
Tungsten	M	SW6010(2				
Vanadium	M	(2)				
Zinc	M	(2)				

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

Parameter	Type (1)	Method (2)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration SOLIDS (PPM)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration LIQUIDS (mg/l)	STATE BENCHMARKS (b) Maximum allowed Concentration SOLIDS (PPM)	STATE BENCHMARKS (b) Maximum allowed Concentration LIQUIDS (mg/l)
Aldicarb	P		1.253 E+0	6.309 E-02		
Aldicarb Sulfone	P					
Aldicarb Sulfoxide	P					
Aldrin	P	(2)	1.351 E-03	1.262 E-05		
Carbofuran	P	(2C)				
Chloranil	P					
Chlordane	P	(2)	1.944 E+01	1.262 E-02		
Chlorpyrifos	P	(2)				
DDT	P	(2)	3.109 E+0	6.309 E-04		
DDT Metabolite (DDD)	P	(2)	5.982 E-02	6.309 E-04		
DDT Metabolite (DDE)	P	(2)	9.902 E-01	6.309 E-04		
Demeton	P	(2)				
Diazinon	P	(2)				
Dieldrin	P	(2)	1.292 E-03	1.262 E-05		
Endosulfan I	P	(2)				
Endosulfan II	P	(2)				
Endosulfan sulfate	P	(2)				
Endrin	P	(2)	1.004 E+0	1.262 E-03		
Endrin Aldehyde	P	(2B)				
Endrin Ketone	P	(2B)				
Guthion (Azinphos methyl)	P	(2)				
Heptachlor	P	(2)	3.345 E+0	2.524 E-03		
Heptachlor Epoxide	P	(2)	8.346 E-01	1.262 E-03		
Hexachlorocyclohexane, Alpha	P	(2)				
Hexachlorocyclohexane, Beta	P	(2)				
Hexachlorocyclohexane (HCH or BHC)	P					
Hexachlorocyclohexane, Delta	P	(2)				
Hexachlorocyclohexane, Technical (Total)	P	(2E)				
Hexachlorocyclohexane, Gamma (Lindane	P	(2)				
Malathion	P	(2B)				

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

			FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
Parameter	Type (1)	Method (2)	SOLIDS (PPM)	LIQUIDS (mg/l)	SOLIDS (PPM)	LIQUIDS (mg/l)
Methoxychlor	P	(2)	2.633 E+04	6.309 E-01		
Mirex	P					
Oxamyl (Vydate)	P					
Parathion	P	(2B)				
Toxaphene	P	(2)	7.909 E+01	3.155 E-02		
Vaponite 2	P					
Aroclor 1016	PP	(2)				
Aroclor 1221	PP	(2)				
Aroclor 1232	PP	(2)				
Aroclor 1242	PP	(2)				
Aroclor 1248	PP	(2)				
Aroclor 1254	PP	(2)				
Aroclor 1260	PP	(2)				
PCBs (Total)	PP	(2)	1.223 E+01	3.155 E-03		
2,4,5-TP Silvex	H	(2C)	9.905 E+0	6.309 E-02		
2,4-Dichlorophenoxyacetic Acid(2,4-D)	H	(2C)	1.069 E+02	6.309 E-04		
Acrolein	H		1.181 E+0	3.15 E+0		
Atrazine	H	(2D)				
Bromacil	H					
Dalapon	H	(2)				
Dinoseb	H	(2)				
Diquat	H					
Endothall	H					
Glyphosate	H					
Picloram	H					
Simazine	H	(2D)				
Americium (Total) (pCi/l)	R					
Americium 241 (pCi/l)	R					

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

Parameter	Type (1)	Method (2)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration SOLIDS (PPM)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration LIQUIDS (mg/l)	STATE BENCHMARKS (b) Maximum allowed Concentration SOLIDS (PPM)	STATE BENCHMARKS (b) Maximum allowed Concentration LIQUIDS (mg/l)
Cesium 134 (pCi/l)	R					
Cesium 137 (pCi/l)	R					
Gross Alpha (pCi/l)	R				5.0 pCi/g	
Gross Beta (pCi/l)	R				50.0 pCi/g	
Plutonium (Total) (pCi/l)	R					
Plutonium 238+239+240 (pCi/l)	R				0.9 pCi/g	
Radium 226+228 (pCi/l)	R					
Strontium 89+90 (pCi/l)	R					
Strontium 90 (pCi/l)	R					
Thorium 230+232 (pCi/l)	R					
Tritium (pCi/l)	R					
Uranium 233+234 (pCi/l)	R					
Uranium 235 (pCi/l)	R					
Uranium 238 (pCi/l)	R					
Uranium (Total)(pCi/l)	R					
1,2,4,5-Tetrachlorobenzene	SV	(2B)	5.603 E+01	6.309 E-02		
1,2,4-Trichlorobenzene	SV	(2)	1.217 E+04	4.4165 E+0		
1,2-Dichlorobenzene (Ortho)	SV	(2)	4.999 E+03	3.785 E+0		
1,2-Diphenylhydrazine	SV	(2B)	6.976 E-04	2.524 E-04		
1,3-Dichlorobenzene (Meta)	SV	(2)	4.790 E+04	1.893 E+0		
1,4-Dichlorobenzene (Para)	SV	(2)	2.650 E+02	4.732 E-01		
2,4,5-Trichlorophenol	SV	(2)	2.101 E+04	2.524 E+01		
2,4,6-Trichlorophenol	SV	(2)	3.536 E-01	1.262 E-02		
2,4-Dichlorophenol	SV	(2)	4.329 E+04	6.309 E-01		
2,4-Dimethylphenol	SV	(2)	1.248 E+01	1.262 E-01		
2,4-Dinitrophenol	SV	(2)	2.296 E+01	4.416 E-04		
2,4-Dinitrotoluene	SV	(2)				
2,6-Dinitrotoluene	SV	(2)				
2-Chloronaphthalene	SV	(2)				
2-Chlorophenol	SV	(2)	4.412 E+04	1.262 E+0		

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

Parameter	Type (1)	Method (2)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration SOLIDS (PPM)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration LIQUIDS (mg/l)	STATE BENCHMARKS (b) Maximum allowed Concentration SOLIDS (PPM)	STATE BENCHMARKS (b) Maximum allowed Concentration LIQUIDS (mg/l)
2-Methylnaphthalene	SV	(2)				
2-Methylphenol	SV	(2)				
2-Nitroaniline	SV	(2)				
2-Nitrophenol	SV	(2)				
3,3'-Dichlorobenzidine	SV	(2)	5.656 E-02	5.047 E-04		
3-Nitroaniline	SV	(2)				
4,6-Dinitro-2-methylphenol	SV	(2)				
4-Bromophenyl-phenyl-ether	SV	(2)				
4-Chloroaniline	SV	(2)				
4-Chlorophenyl-phenyl-ether	SV	(2)				
4-Chloro-3-methylphenol	SV	(2)				
4-Methylphenol	SV	(2)				
4-Nitroaniline	SV	(2)				
4-Nitrophenol	SV	(2)				
Acenaphthene	SV	(2)				
Anthracene	SV	(2)	7.701 E+01	1.262 E-02		
Benzidine	SV	(2BC)	1.262 E-06	1.262 E-06		
Benzoic Acid	SV	(2)				
Benzo(a)anthracene	SV	(2)	9.690 E-02	6.309 E-05		
Benzo(a)pyrene	SV	(2)	3.8675 E-0	1.893 E-05		
Benzo(b)fluoranthene	SV	(2)	1.643 E-04	1.262 E-04		
Benzo(g,h,i)perylene	SV	(2)				
Benzo(k)fluoranthene	SV	(2)	7.790 E+02	2.524 E-02		
Benzyl Alcohol	SV	(2)				
bis(2-Chloroethoxy)methane	SV	(2)				
bis(2-Chloroethyl)ether	SV	(2)	1.893 E-04	1.893 E-04		
bis(Chloromethyl)ether	SV					
bis(2-Chloroisopropyl)ether	SV	(2)	2.234 E+03	6.309 E+0		
bis(2-Ethylhexyl)phthalate (Di(2-ethylhex	SV	(2)	4.210 E+01	1.893 E-02		
Butadiene	SV					
Butylbenzylphthalate	SV	(2)	6.375 E+04	5.678 E+0		

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

Parameter	Type (1)	Method (2)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration SOLIDS (PPM)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration LIQUIDS (mg/l)	STATE BENCHMARKS (b) Maximum allowed Concentration SOLIDS (PPM)	STATE BENCHMARKS (b) Maximum allowed Concentration LIQUIDS (mg/l)
Chlorinated Ethers	SV	(2)				
Chlorinated Napthalenes	SV	(2)				
Chloroalkylethers	SV	(2)				
Chrysene	SV	(2)	1.516 E+01	1.262 E-03		
Dibenzofuran	SV	(2)				
Dibenz(a,h)anthracene	SV	(2)	7.318 E-03	4.416 E-06		
Dichlorobenzenes	SV	(2)				
Diethylphthalate	SV	(2)	4.795 E+05	1.893 E+02		
Di(2-ethylhexyl)adipate	SV					
Dimethylphthalate	SV	(2)	9.232 E+06	2.524 E+03		
Di-n-butylphthalate	SV	(2)				
Di-n-octylphthalate	SV	(2)	3.441 E+04	3.785 E+0		
Ethylene Glycol	SV	(2C)				
Fluoranthene	SV	(2)	2.971 E+04	1.262 E+0		
Fluorene	SV	(2)	1.048 E+01	1.262 E-02		
Formaldehyde	SV					
Haloethers	SV	(2)				
Hexachlorobenzene	SV	(2)	2.619 E-01	1.262 E-04		
Hexachlorobutadiene	SV	(2)	5.139 E+0	3.155 E-03		
Hexachlorocyclopentadiene	SV	(2)	8.283 E+03	1.262 E+0		
Hexachloroethane	SV	(2)	2.956 E+0	1.893 E-02		
Hydrazine	SV		6.309 E-05	6.309 E-05		
Indeno(1,2,3-cd)pyrene	SV	(2)	2.970 E+04	1.262 E-03		
Isophorone	SV	(2)	1.345 E+04	4.416 E+01		
Naphthalene	SV	(2)	5.738 E+05	6.309 E+01		
Nitrobenzene	SV	(2)	6.557 E+0	1.262 E-01		
Nitrophenols	SV	(2)				
Nitrosamines	SV	(2)				
N-Nitrosodibutylamine	SV	(2B)				
N-Nitrosodiethylamine	SV	(2B)				
N-Nitrosodimethylamine	SV	(2B)				

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

Parameter	Type (1)	Method (2)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
			SOLIDS (PPM)	LIQUIDS (mg/l)	SOLIDS (PPM)	LIQUIDS (mg/l)
N-Nitrosopyrrolidine	SV	(2B)	1.262 E-04	1.262 E-04		
N-Nitrosodiphenylamine	SV	(2B)	6.309 E-05	6.309 E-05		
N-Nitroso-di-n-dipropylamine	SV	(2B)				
Pentachlorinated Ethanes	SV	(2B)				
Pentachlorobenzene	SV	(2B)	2.284 E+03	1.893 E-04		
Pentachlorophenol	SV	(2)	2.917 E+03	1.262 E+0		
Phenanthrene	SV	(2)	1.398 E+01	1.262 E-02		
Phenol	SV	(2)	2.051 E+04	1.262 E-02		
Phthalate Esters	SV	(2)				
Polynuclear Aromatic Hydrocarbons	SV	(2)				
Pyrene	SV	(2)	4.076 E+05	6.309 E+0		
Vinyl Chloride	V	(2)	1.822 E-01	1.262 E-02		
1,1,1-Trichloroethane	V	(2)	2.229 E+02	1.262 E+0		
1,1,2,2-Tetrachloroethane	V	(2)	5.832 E-03	1.262 E-03		
1,1,2-Trichloroethane	V	(2)	2.315 E-02	3.785 E-03		
1,1-Dichloroethane	V	(2)	1.140 E-02	2.254 E-03		
1,1-Dichloroethene	V	(2)	1.270 E+0	4.416 E-02		
1,2-Dichloroethane	V	(2)	3.717 E-01	3.155 E-02		
1,2-Dichloroethene (cis)	V	(2A)	2.973 E+01	4.416 E-7		
1,2-Dichloroethene (total)	V	(2)				
1,2-Dichloroethene (trans)	V	(2A)	3.641 E+01	6.309 E-01		
1,2-Dichloropropane	V	(2)	6.995 E-01	3.155 E-02		
1,3-Dichloropropene (cis)	V	(2)				
1,3-Dichloropropene (trans)	V	(2)				
2-Butanone	V	(2)				
2-Hexanone	V	(2)				
4-Methyl-2-pentanone	V	(2)				
Acetone	V	(2)	5.170 E+02	2.524 E+01		
Acrylonitrile	V	(2B)	3.785 E-04	3.785 E-04		
Benzene	V	(2)	8.879 E-01	3.156 E-02		

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

			FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
Parameter	Type (1)	Method (2)	SOLIDS (PPM)	LIQUIDS (mg/l)	SOLIDS (PPM)	LIQUIDS (mg/l)
Bromodichloromethane	V	(2)	7.546 E+02	4.4165 E+0		
Bromoform	V	(2)				
Bromomethane	V	(2)	3.606 E+01	3.155 E-01		
Carbon Disulfide	V	(2)	1.277 E+04	2.524 E+01		
Carbon Tetrachloride	V	(2)	1.408 E+0	3.155 E-02		
Chlorinated Benzenes	V/SV	(2)				
Chlorobenzene	V	(2)	1.526 E+02	6.309 E-01		
Chloroethane	V	(2)				
Chloroform	V	(2)	4.968 E-01	3.785 E-02		
Chloromethane	V	(2)				
Dibromochloromethane	V	(2)				
Dichloroethenes	V	(2)				
Ethylbenzene	V	(2)	4.984 E+03	4.416 E+0		
Ethylene Dibromide	V	(2C)	6.078 E-04	3.155 E-04		
Ethylene Oxide	V		6.309 E-04	6.309 E-04		
Halomethanes	V	(2)				
Methylene Chloride	V	(2)				
Styrene	V	(2)	2.343 E+0	3.155 E-02		
Tetrachloroethanes	V	(2)				
Tetrachloroethene	V	(2)	3.480 E+0	3.155 E-02		
Toluene	V	(2)	1.173 E+04	1.262 E+01		
Trichloroethanes	V	(2)				
Trichloroethene	V	(2)	1.146 E+0	3.155 E-02		
Vinyl Acetate	V	(2)				
Xylenes (total)	V	(2)				

EXPLANATION OF TABLE AND ENDNOTES

CDH = Colorado Department of Health
EPA = Environmental Protection Agency

TABLE E - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (December 16, 1992)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/Kg UNLESS OTHERWISE NOTED

			FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
Parameter	Type (1)	Method (2)	SOLIDS (PPM)	LIQUIDS (mg/l)	SOLIDS (PPM)	LIQUIDS (mg/l)

pCi/g = picocuries per gram
PCB = polychlorinated biphenyl
RCRA = Resource Conservation Recovery Act
RFP = Rocky Flats Plant
SDWA = Safe Drinking Water Act
TIC = Tentatively Identified Compound
mg/Kg = milligrams per kilogram

(1) Type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; FP=field parameter; H=herbicide; IN=inorganic; M=metal; P=pes
PP= pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile
(2) See Attachment 1 for analytical methods with corresponding analytes and detection limits
abbreviations are: E=EPA; SW=SW846; A=detected as total; B=detected as TICs; C=not routinely monitored; D=monitored in discharge ponds;
E=mixture-individual isomers detected

(a) EPA Guidance 9347.3-09FS, A Guide to Delisting of RCRA Wastes for Superfund Remedial Responses: Based on Health-based 10-6 risk, develo
delisting hazardous wastes and waste residuals.
(b) Value derived from Colorado Radiation Control Rules and Regulations, 1985 as amended 1990.

TABLE F - POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (DECEMBER 1
AIR QUALITY STANDARDS
ALL VALUES ARE IN ug/m3 UNLESS OTHERWISE NOTED

Parameter	Type (1)	Method	FEDERAL STANDA (3)	STATE STANDA (3)
Lead	M	12	1.5 ug/m3 (a)	1.5 ug/m3 (a)
Beryllium	M	See Attachment 1		0.01ug/l
Ozone	I	40CFR50 App D	235 ug/m3 (b)	235 ug/m3 (b)
Americium	R		(2)(c)	(d)
Americium 241	R		(2)(c)	(d)
Cesium 134	R		(2)(c)	(d)
Cesium 137	R		(2)(c)	(d)
Gross Alpha	R		(2)(c)	(d)
Gross Beta	R		(2)(c)	(d)
Plutonium	R		(2)(c)	(d)
Plutonium 238+239+240	R		(2)(c)	(d)
Radium 226+228	R		(2)(c)	(d)
Strontium 89+90	R		(2)(c)	(d)
Strontium 90	R		(2)(c)	(d)
Thorium 230+232	R		(2)(c)	(d)
Tritium	R		(2)(c)	(d)
Uranium 233+234	R		(2)(c)	(d)
Uranium 235	R		(2)(c)	(d)
Uranium 238	R		(2)(c)	(d)
Uranium (Total)	R		(2)(c)	(d)

EXPLANATION OF TABLE AND ENDNOTES

CCR = Code of Colorado Regulations
CDH = Colorado Department of Health
CFR = Code of Federal Regulations
RFP = Rocky Flats Plant
ug/m3 = micrograms per cubic meter

(1) Type abbreviations are: IN=inorganic; M=metal; R=radionuclides
(2) 10 mrem/yr to the general public
(3) Where the standard is below (more stringent than) the PQL, the PQL is interpreted to be compliance level

(a) National Ambient Air Quality Standard (Calender Quarter) primary and secondary
(b) National Ambient Air Quality Standard, (1 hour) primary and secondary
(c) National Emission Standard Hazardous Air Pollutants 40 CFR 61 Subpart H
(d) Requirements of State Implementation Plan (SIP) under Section 110 of the Clean Air Act as implemented by State SIP of October 5, 1979, as amended and 5 CCR 1001-3.

TITLE: DOOs | Approved By:

04/01/93
Effective Date

Manager

/ /
Date

5.0 DATA QUALITY OBJECTIVES AND DATA NEEDS

5.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are established to define data needs for each of the RFI/RI tasks, coordinate collection activities to support those needs, and to assure the quality and quantity of resultant data. Collectively the data are used to make decisions regarding the risks the site poses to human health and the environment and to make decisions regarding which remedial measures are appropriate to mitigate the risks. DQOs are developed interactively with ongoing RFI/RI activities. The DQO development process is flexible, iterative, and dependant upon evaluation of existing data, and data that become available as a result of RFI/RI activities. Three stages are used in the development of DQOs, and each of the stages is outlined below (EPA, 1987).

Stage 1 - Identify Decision Types

- Identify and involve data users;
- Evaluate available data;
- Develop a conceptual model of the study site; and
- Specify RFI/RI objectives, and anticipate the decisions necessary to achieve the objectives.

Stage 2 - Identify Data Uses and Needs

- Identify data uses;
- Identify data types;
- Identify data quality needs;

- Identify data quantity needs;
- Evaluate sampling and analysis options; and
- Review data precision, accuracy, representativeness, completeness, and comparability (PARCC).

Stage 3 - Design Data Collection Program

- Assemble data collection components; and
- Develop data collection documentation.

The DQO elements are continually revised and reevaluated on the basis of new data developed during each phase of the RFI/RI. As the environmental characteristics and the nature of contamination of the study area become better understood, additional data requirements will become apparent and both the DQOs and the Field Sampling and Analysis Plan (FSAP) may evolve in response to these requirements. The following discussion addresses each of the DQO elements.

5.1.1 Stage 1 Identification of Decision Types

5.1.1.1 Identification of Data Users

The following is a list of agencies and organizations that are the principal decision makers and end-users of data that will be generated during the OU 13 Phase I RFI/RI (ERP, 1991).

United States Environmental Protection Agency, Region VIII, Waste Management Division Director, Federal Facilities Branch Chief, and the Rocky Flats Remedial Project Manager.

State of Colorado Department of Health, Hazardous Materials and Waste Management Division Director, Hazardous Waste Section Leader, Hazardous Waste Facilities Unit Leader, and the Monitoring and Enforcement Unit Leader.

United States Department of Energy, Office of Environmental Restoration and Waste Management, Secretary of Energy, and the Acting Assistant Secretary for Environmental Restoration and Waste Management.

United States Department of Energy, Rocky Flats Office Manager, Assistant Manager for Environmental Management, and the Acting Environmental Restoration Division Director.

EG&G Rocky Flats Plant, Environmental Management Department, Associate General Manager for Environmental Restoration and Waste Management, Environmental Management Department Director, Environmental Management Department Division Managers, and matrix project personnel from other Rocky Flats Plant or external EG&G organizations.

EG&G Rocky Flats Plant technical specialists and subcontractors responsible for supervising, coordinating and performing Environmental Restoration activities (ERP, 1991i).

5.1.1.2 Evaluation of Available Data

Existing data are described in Section 2 of this document. Soils and geologic data collection activities in the vicinity of OU 13 have been primarily directed toward defining the RFP environmental setting. Much of the data were developed as a result of the RFP Geological Characterization including chemical data used to characterize the types and sources of contamination present in the soils and groundwater. Chemical data continue to be collected from monitoring well 4486 as part of the overall RFP characterization monitoring program. The available soils and geology data were not developed for the specific purpose of characterizing OU 13.

Existing ambient air monitoring programs characterize the RFP site on an area-wide basis for plutonium and americium. This data is not specific to any of the OU 13 IHSS sources, but provides a baseline for the RFP and is collected according to air sampling procedures specified in EMD Operating Procedures Manual No. 5-21000-OPS-AP, Volume VI, Air.

Surface water data (VOCs, metals, water quality, and radiochemistry) for OU 13 are available from seven sampling stations (SED118, SW018, SW019, SW020, SW022, SW023, and SW093). Four of the stations (SW019, SW020, SW022, and SW023) are located within OU 13; however, only SW019 is in a location that receives runoff from OU 13. The seven other surface water sampling stations receive runoff from other OUs.

Data for air quality, surface water, groundwater, soils, and geology are being validated in accordance with sections 3.4 and 3.7 of the QAPjP for data validation guidelines and data usability criteria respectively. Some of the data are validated and accepted, some are validated with qualifications, some have been rejected, and some have yet to go through the validation process. Appendices D, E, and F list the available analytical data and identify which samples have been validated. A summary evaluation of the data available for each IHSS located in OU 13 is given below.

North Chemical Storage Site (IHSS 117.1). This site was used to store non-radioactive construction debris, waste metal, and scrap metal. Existing data for this site are available from piezometers and groundwater monitor wells P114789, P214689, P115589, and P218089. The available data characterize the site's soils and geology. Limited surficial soils data was collected as part of a site-wide PCB investigation in 1991. This data shows no radionuclide contamination.

Middle Chemical Storage Site (IHSS 117.2). This site was used as a non-radioactive chemical storage facility. Existing soils and geologic data for this are limited to piezometers located in the vicinity of the site. These piezometers are P115589, P213689, and P214089.

South Chemical Storage Site (IHSS 117.3). This site was used as a storage area for pallets, cargo containers and new drums, and in one instance it is believed the site was used for the storage of a contaminated glovebox. Existing data for this site characterize soils geology and groundwater in the vicinity. These data are available from piezometers and monitor wells P313489, P418289, 6186. A radiometric survey for gross contamination was conducted for this area.

Oil Burn Pit Number 1 Waste Leak (IHSS 128). Approximately 200 gallons of radioactively contaminated waste oil were burned in an open pit in 1956. Data for soils and geology are available from piezometer P114889. Air monitoring data collected at the time the oil was burned may also be available.

Lithium Metal Destruction Site (IHSS 134). This area contains the reaction products from oxidation of magnesium and lithium metal coated with machine oils that may have contained perchloroethylene. Existing data for soils and geology are available from piezometers P114889 and P115489.

Waste Spills (IHSS 148). The soils of this site have reportedly been contaminated by spills of nitrates and possibly of unknown radioactive compounds. Existing data for this site is limited to a radiometric survey for gross contamination and surface water sampling station SW019.

Fuel Oil Tank (IHSS 152). This facility consists of an 800,000-gallon storage tank that is presently in operation, surrounded by an earthen dike, and containing No. 6 fuel oil. Approximately 700 gallons of fuel oil was spilled, cleaned up, and recycled in 1971. A similar spill of 400 gallons occurred in 1979. Existing data for this site is limited to a radiometric survey that indicated low levels of radioactivity were present.

North Area Radioactive Site (IHSS 157.1). This site is contaminated with unknown volumes of depleted uranium and beryllium. Existing data for this site include groundwater data from monitor well 4486, soil samples taken in the year 1953, and a radiometric survey for gross contamination.

Building 551 Radioactive Site (IHSS 158). This site was used as loading area and as a temporary holding area for items contaminated with low levels of uranium. Existing data for this site include soils and geology data from piezometers P115589 and P214689. Limited surficial soils data was collected as part of a site-wide PCB investigation in 1991. This data shows no radionuclide contamination.

Waste Peroxide Drum Burial (IHSS 169). This site is the reported location of a buried single 55-gallon drum of hydrogen peroxide. This incident is probably the same incident described as IHSS 191. The evaluation of available data for IHSS 191 is given below.

Solvent Burning Ground (IHSS 171). This site was used for training fire-fighting personnel and may be contaminated with waste oil and gasoline. Existing data characterizing this site's soils and geology are available from piezometer P114889.

Valve Vault (IHSS 186). This was the site of a process waste line leak. Unknown volumes of liquid waste carrying radioactive constituents and other unknown chemicals leaked into the soil at this location. Existing data for soils and geology are available from piezometer P114789.

Caustic Leak (IHSS 190). This was the site of two leaks of sodium hydroxide from an above-ground storage tank. One of the leaks resulted in a release to the environment, and the other did not. There are no known sources of soils, geology, or groundwater data for this site. Surface water data is available from sampling station SW019.

Hydrogen Peroxide Spill (IHSS 191). This was the site of a release of hydrogen peroxide from a 55-gallon drum. There do not appear to be any sources of data for this site.

Scrap Metal Sites (IHSS 197) This IHSS was originally one of the Low Priority Sites—OU 16, but was transferred to this OU after the final work plan was submitted for comments. A description of the site is available in the Final No Further Action Justification Document, Rocky Flats Low Priority Sites (Operable Unit 16), July 1992. It is overlaps and is adjacent to IHSS 117.1. Scrap metal components of early construction were reported to be buried in this area in the late 1950s or early 1960s. In 1981, during the construction of the new Protected Area perimeter fence, construction debris was discovered and work began to remove it. The material unearthed was moist, but not oily, scrap metal consisting of machine turnings, rings, shapes, overlays and other metal parts.. The materials were monitored for radiation with a FIDLER, but none was detected. In addition, total long-lived alpha concentrations from three portable air samplers at the Building 559 cleanup area showed zero count. No transformers or related materials were found.

5.1.1.3 Site Conceptual Model

Conceptual models of IHSSs in OU 13 have been developed and are presented in Section 2.3 of this document. The models include a description of potential sources of contamination, release mechanisms, transport media, exposure routes, and potential receptors. The conceptual models were developed by organizing the IHSSs into two logical groups based upon the secondary source type, potential exposure routes and transport mechanisms. The two groups and the IHSSs that compose each group are listed below. IHSSs 128 and 148 are listed in both groups because they each exhibit characteristics of both groups.

- Releases originating above ground and affecting surficial materials: 117.1, 117.2, 117.3, 128, 134, 148, 152, 157.1, 158, 171, 190, and 191.

- Releases originating and affecting transport media below the ground surface: 128, 148, and 186.

The conceptual models will be an aid in identifying exposure pathways and to evaluate the potential risks to human health and the environment posed by the contamination present in OU 13.

5.1.1.4 Data Objectives and Decisions

The DQO process requires that specific data objectives be defined; formulation of the objectives leads to the identification of data needs. The data objectives for the OU 13 RFI/RI Work Plan are summarized in Table 5.1. Data needs are expected to evolve based upon new information generated as the Work Plan is implemented. From the information generated by the RFI/RI, decisions can be made regarding whether remediation is necessary and which remedial alternatives would be appropriate.

5.1.2 Stage 2 - Identify Data Uses and Needs

5.1.2.1 Identify Data Uses

The principal uses of RFI/RI data have been defined in Data Quality Objectives for Remedial Response Activities and are listed below (EPA, 1987).

- **Site Characterization** - data are used to determine the nature and extent of contamination at a site;

- **Health and Safety** - data are used to establish the level of protection needed for onsite workers and to determine if there is imminent danger to the surrounding population;

- **Risk Assessment** - data are used to evaluate the threat posed by the site to public health and the environment;
- **Evaluation of Alternatives** - data are used to evaluate which remedial technologies may be appropriate;
- **Engineering Design of Alternatives** - data are used in the remedial design process to evaluate the performance of various remedial technologies;
- **Monitoring During Remedial Action** - after remedial actions are implemented, data are used to assess their effectiveness; and
- **Correlation of Environmental Contamination to Responsible Party(s)** - data are used to link wastes detected in the environment to wastes known to be onsite.

Data uses specific to RFI/RI Phase I sampling and analysis activities for OU 13 are listed in Table 5.2.

5.1.2.2 Identify Data Types

Data types required for the OU 13 RFI/RI are: air quality, soil engineering/geotechnical, soil-gas, soil chemistry, aquifer parameters, and groundwater chemistry. Table 5.1 provides additional information on the types of data that will be collected.

5.1.2.3 Identify Data Quality Needs

The level of data quality required for OU 13 RFI/RI activities is based upon the following factors: appropriate analytical levels, potential contaminants that may be present, level of concern and required detection limit. Each of these factors is discussed below.

Appropriate analytical levels for RFI/RI work are listed below (EPA, 1987).

- **Level I** Field portable instruments. Results are typically not compound-specific or quantitative. This analytical level is appropriate for providing real-time health and safety data and as a screening tool to indicate potentially contaminated areas.

Table 5.1 Phase I RFI/RI Analytical Data Quality Objectives

Specific Objective (Data Need)	Data Type	Sampling/Analysis Activity	Analytical Level	Data Use
Establish the presence or absence of contaminants	Soil gas, HPGe, soil and groundwater data	For each IHSS, conduct HPGe radiation survey, soil gas survey, collect surface soil samples, subsurface soil samples, and groundwater samples, and asphalt samples, as necessary	II for HPGe radiation survey, IV for conventional analytes, & V for radiological analytes	• Contaminant source and multi-media characterization
Characterize the environmental setting of each IHSS				
Subsurface stratigraphy and characteristics of subsurface materials	Geologic description	Evaluate applicability of existing data from adjoining IHSS's, drill boreholes and log subsurface materials	I	• Soil and Subsurface Characterization
Depth to groundwater	Water level data	Water level data from existing wells, piezometers and newly installed boreholes	I	• Subsurface Characterization
Groundwater flow regime	Water level data and aquifer tests	Evaluate applicability of newly developed aquifer data from adjoining Operable Units	I	• Aquifer Characterization
Vadose water flow regime	Soil moisture data and matric potential measurements	Evaluate applicability of newly developed vadose zone data from STP vadose characterization and the OU2 vadose study	I	• Vadose Zone Characterization
Characterize the nature and extent of contamination				
Affected media including location, concentration, type, physical state, and quantity of contaminants	Surface water, soil and groundwater data	For each IHSS, conduct HPGe radiation survey, soil gas survey, collect surface soil samples, subsurface soil samples, and groundwater samples, and asphalt samples, as necessary	IV for conventional analytes and V for radiological analytes	• Site Characterization • Evaluation of Remedial Alternatives • Risk Assessment

Table 5.1 Phase I RFI/RI Analytical Data Quality Objectives - continued

Specific Objective (Data Need)	Data Type	Sampling/Analysis Activity	Analytical Level	Data Use
Assess fate and transport of contaminants	Soil and aquifer physical parameters	Evaluate applicability of newly developed aquifer data from adjoining Operable Units and vadose zone data from STP vadose characterization and the OU2 vadose study	I	• Risk Assessment
Assess risk to human health and environment	Data types indicated above	Synthesis of RFI/RI data	I	• Risk Assessment
Identify applicable remedial measures	Data types indicated above	Synthesis of RFI/RI data	I	• Evaluation of Remedial Alternatives

Table 5.2
(sheet 1 of 2)

SAMPLING ACTIVITY OBJECTIVES FOR EACH STAGE OF PHASE I REMEDIAL INVESTIGATION

Activity	Stage 1	Stage 2	Stage 3
Radiation Survey	Screen surface for radiochemical contamination; map anomalies for further subsurface investigation	N/A	N/A
Soil Gas Survey	determine presence or absence of listed analytes in the subsurface; map anomalous areas for further investigation, delineate horizonal extent of contamination	N/A	N/A
Surficial Soils Scrapes	determine presence or absence of listed analytes in the subsurface; map anomalous areas for further investigation, delineate horizonal extent of contamination, begin to develop data for baseline risk assessment	provide additional detail to support the baseline risk assessment, if needed.	provide new information for Feasibility Study if needed.

Table 5.2
(sheet 2 of 2)

SAMPLING ACTIVITY OBJECTIVES FOR EACH STAGE OF PHASE I REMEDIAL INVESTIGATION

Groundwater	determine presence or absence of contamination in existing nearby wells and piezometers	supplement existing wells and piezometers with BAT Hydropunch to develop OU model for Transport and Fate of contaminants	provide additional information if needed
Surface Water and Sediments	establish presence or absence of contamination in the sump at IHSS 171 and at many locations through out the Industrial Area of the plant	provide additional information as deemed necessary from the Stage 1 results	provide additional information as deemed necessary from the Stage 2 results
Boreholes	determine the presence or absence of contamination resulting from subsurfaces releases at IHSSs 128&148	confirm anomalous findings from stage 1, begin to determine nature and extent of contamination in the subsurface	provide additional information as deemed necessary from the Stage 2 results

- **Level II** Mobile laboratories and field gas chromatograph/mass spectrometer (GC/MS) units. Results may be compound-specific and quantitative depending on instrument calibration, reference standards, equipment condition, and operator capability. Real-time data may be available, or results may be produced in several hours. This analytical level is appropriate during the site characterization, evaluation of remedial alternatives, engineering design, and during site monitoring.

- **Level III** Offsite analytical laboratory. Results generally have a greater degree of analytical precision than Level II. Data may be available in 24 hours or in several days to weeks. Level III is an appropriate level for some phases of site characterization, evaluation of remedial alternatives, engineering design, responsible party determination, and during site monitoring. Level III may be appropriate for risk assessment depending on the outcome of RFP policy decisions.

- **Level IV** EPA Contract Laboratory Program methods are required. The analytical precision is similar to that of Level III, but stringent quality assurance and quality control protocol are formally documented. Laboratory turn-around time for reporting analytical results are similar to those described for Level III.

- **Level V** Offsite analytical laboratory using non-standard methods. Analytical method development or modification is required, and analytical precision and reporting schedules may vary according to the method.

Analytical Level I, II, IV and V will be used during implementation of the OU 13 RFI/RI. The analytical methods that will be used are those specified in the EG&G Rocky Flats General Radiochemistry and Routine Analytical Services Protocol (GRRASP), Parts A and B.

Potential contaminants have been identified based upon their toxicity, persistence in the environment, and frequency of occurrence. The potential contaminants present are listed in Table 5.3, but the list is expected to evolve as additional data become available.

Levels of concern are based upon available health standards and are expressed as contaminant-specific concentration ranges that serve as guidelines for selecting analytical methods, detection limits and in determining the boundaries of field investigations.

Table 5.3
(sheet 1 of 2)
POTENTIAL CONTAMINANTS PRESENT IN OU 13

IHSS Number	Potential Contaminants Present
117.1/197	plutonium 239/240, radium 226, radium 228, tritium, uranium 233/234, uranium 235, uranium 238, acetone, cadmium, copper, toluene, benzene, carbon disulfide, ethylbenzene, xylenes, strontium 89/90
117.2	plutonium 239/240, radium 226, radium 228, uranium 233/234, uranium 235, uranium 238, tritium, arsenic, beryllium, cadmium, copper, chromium, lead, mercury, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethene, 1,1-dichloroethane, 1,1,-dichloroethene, 1,2 dichloroethene, tetrachloroethene, trichloroethene, 2-butanone, toluene,, xylenes, acetone, strontium 89/90
117.3	plutonium 239/240, oils, and solvents
128	plutonium 239/240, radium 226, radium 228, uranium 233/234, uranium 238, carbon disulfide, and acetone perchloroethene
134	plutonium 239/240, radium 226, uranium 233/234, uranium 235, uranium 238, arsenic, copper, lead, lithium, magnesium, zinc, acetone, toluene, total petroleum hydrocarbons, and solvents
148	plutonium 239/240, radium 226, radium 228, uranium 233/234, uranium 235, uranium 238, tritium, and nitrates
152	total petroleum hydrocarbons

Table 5.3
(sheet 2 of 2)
POTENTIAL CONTAMINANTS PRESENT IN OU 13

157.1	uranium 233/234, uranium 238, PCE, acetone, chloroform 1,1,1-tetrachloroethane, 1,1-dichloroethane, tetrachloroethene, chloride, beryllium, lead, and mercury
158	plutonium 239/240, radium 226, radium 228, tritium, uranium 233/234, uranium 235, uranium 238, arsenic, chromium, lead, mercury, cadmium, copper, toluene, benzene, carbon disulfide, acetone, ethylbenzene, xylene, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethene, 1,1-dichloroethane, 1,1,-dichloroethene, 1,2 dichloroethene, tetrachloroethene, trichloroethene, 2-butanone, and xylenes
171	plutonium 239/240, radium 226, radium 228, uranium 233/234, uranium 238, carbon disulfide, acetone, and magnesium fuel oil gasoline
186	americium 241, plutonium 239/240, radium 226, uranium 233/234, uranium 235, uranium 238, acetone, benzene, carbon disulfide, ethylbenzene, toluene, xylenes, chloride, and sulfate
190	sodium hydroxide, sulfate, and aluminum
191/169	hydrogen peroxide

Detection limit requirements take into account the levels of concern, RFP chemical-specific Benchmarks in lieu of ARARs, and DQOs specified in the RFP Sitewide Quality Assistance Project Plan (RFP, QAPjP, 1991). Site-specific ARARs will be developed as the initial step in the OU 13 Feasibility Study/Corrective Measures Study. Detection limits are listed in Table 5.4.

5.1.2.4 Identify Data Quantity Needs

Data quantity needs are based on a review of the available environmental data and on the data uses previously described. Data quantity needs are developed in stages as part of the observational philosophy adopted for this project. Simply stated, that approach is based on observing and evaluating the data as work proceeds in stages. Field sampling density is based on a subjective evaluation supported by statistical evaluation. The subjective evaluation includes review of site features to ensure that data are collected at each location where contamination is most likely to have been released.

To ensure that a sufficient quantity of data are collected, the FSAP specifies a three stage approach to data collection. The purpose of Stage 1 is to determine the presence or absence of contamination and to collect sufficient data to efficiently guide data collection in Stages 2 and 3. The purpose of Stage 2 is to confirm Stage 1 findings, and to gather information to define the nature and extent of contamination and to begin to support the baseline risk assessment . The purpose of Stage 3 is to complete the collection of data needed to complete the RFI/RI investigation. Since the data quantity needed in Stage 2 is based on the results of Stage 1 and the data quantity needed in Stage 3 is based on the results of Stage 1 and Stage 2, only Stage 1 data needs will be completely specified in this Work Plan, although the basis for establishing Stage 2 and 3 data needs will be discussed. Table 5.2 defines these objectives for each sampling activity at each stage of the investigation.

The FSAP (Section 6) specifies the objectives and analytic methods for each IHSS for Stage 1. The design of the sampling program is based on the probability of detecting contamination within a given area to a specified level. Each analytic method has its own objective, and is supported by a specific statistical approach.

TABLE 5.4

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS FOR SAMPLING ACTIVITIES AT OU13

TARGET COMPOUND LIST VOLATILES

	Water Limits (ug/L)	Soil Limits ug/Kg
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichlorothene (total)	5	5
Chloroform	5	5
1,2-Dichloroethane	1	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	5	5
Trichlorothene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	5	5
trans-1,2-Dichloropropene	5	5
Bromoform	5	5
4-Methyl-2-pentanone	10	10
2-Hexanone	10	10

Detection limits are identified in the QAPjP.
EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise.

TABLE 5.4—CONTINUED

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS FOR SAMPLING ACTIVITIES AT OU13

TARGET ANALYTE LIST METALS

	Water Limits (ug/L)	Soil Limits (mg/Kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1
Cadmium	5	1
Calcium	5000	2000
Chromium	10	2
Cobalt	50	10
Copper	25	5
Cyanide	5	10
Iron	100	20
Lead	3	1
Magnesium	5000	2000
Manganese	15	3
Mercury	.2	.2
Nickel	40	8
Potassium	5000	2000
Selenium	5	1
Silver	10	2
Sodium	10	2
Thallium	10	2
Vanadium	50	10
Zinc	20	4
Lithium	100	20

Detection limits are identified in the QAPjP.
EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise.

TABLE 5.4—CONTINUED

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS FOR SAMPLING ACTIVITIES AT OU13

Anthracene	10	330
Di-n-butylphthalate	10	330
Flouranthene	10	330
Pyrene	10	330
Butyl Benzlyphthalate	10	330
3,3'-Dichlorobenzidine	20	660
Benzo(a)anthracene	10	330
Chrysene	10	330
bis-(2-ethylhexyl)phthalate	10	330
Di-n-octyl Phthalate	10	330
Benzo(b)flouranthene	10	330
Benzo(k)flouranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h)anthracene	10	330
Benzo(g,h,i)perylene	10	330

Detection limits are identified in the QAPjP.
EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise.

TABLE 5.4—CONTINUED

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS
FOR SAMPLING ACTIVITIES AT OU13

TARGET COMPOUND LIST SEMI-VOLATILES		
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronaphthalene	10	330
2-Nitroaniline	50	1600
Dimethylphtalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitrophenol	50	1600
Acenaphthene	10	330
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphtalate	10	330
4-Chlorophenol Phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600

TARGET COMPOUND LIST SEMI-VOLATILES - continued

	Water Limits (ug/L)	Soil Limits (ug/Kg)
N-nitrosodiphenylamine(1)	10	330
4-Bromophenyl-Phenyl ether	10	330
Phenanthrene	10	330

Detection limits are identified in the QAPjP.
EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise.

TABLE 5.4—CONTINUED

TARGET COMPOUND LIST VOLATILES

	Water Limits (ug/L)	Soil Limits ug/Kg
Tetracholoroethene	5	5
Toluene	5	5
1,1,2,2-Tetrachloroethane	5	5
Chlorobenzene	5	5
Ethyl Benzene	5	5
Styrene	5	5
Xylenes (total)	5	5

TARGET COMPOUND LIST SEMI-VOLATILES

Phenol	10	330
bis(2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
1-3-Dichlorobenzene	10	330
1-4-Dichlorobenzene	10	330
Benzyl Alcohol	10	330
1-2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitroso-Dipropylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic Acid	50	1600
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
	Water Limits (ug/L)	Soil Limits (ug/K)
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330

Detection limits are identified in the QAPjP.
EPA Contract Laboratory Method for TCL volatiles will be used unless noted otherwise.

TABLE 5.4—CONTINUED

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS FOR SAMPLING ACTIVITIES AT OU13

SOIL GAS SAMPLES

Parameter	Detection Limit (ug/l)
Acetone	1
Benzene	1
Carbon disulfide	1
Carbon tetrachloride	1
Chloroform	1
Dichloromethane	1
Ethylbenzene	1
Methylene chloride	1
PCE	1
TCE	1
Toluene	1
Xylenes (total)	1
1,1-DCA	1
1,1,1-TCA	1
1,2-DCA	1
2-Butanone	1

Note: Detection limits are a function of the detector type and injection volume. Thus, the detection limit may vary. Target detection limits will be at or below the listed values.

TABLE 5.4

ANALYTICAL PARAMETER AND DETECTION/QUANTITATION LIMITS FOR SAMPLING ACTIVITIES AT OU 13

Other Chemical Compounds		
	Water Limits (pCi/L)	Soil Limits (pCi/g)
Radionuclides		
Gross Alpha, Dissolved	2	4
Gross Beta, Dissolved	4	10
Gross Alpha, Suspended	2	4
Gross Beta, Suspended	4	10
Tritium	400	400
239/240 Plutonium	0.01	0.03
233/234 Uranium	0.6	0.3
235 Uranium	0.6	0.3
238 Uranium	0.6	0.3
241 Americium	0.01	0.02
Total Radiostrontium	1	1
Total Radiocesium	1	0.1
226 Radium	0.5	0.5
228 Radium	1	0.5
244 Curium	1	0.5
237 Neptunium	1	0.5
230 Thorium	1	0.5
232 Thorium	1	0.5
134 Cesium (by Gamma)	1	0.5
127 Cesium (by Gamma)	1	0.5
Anions		
Nitrate	1 mg/L EPA 353.2	5 mg/Kg EPA 353.2
Sulfate	5 mg/L EPA 375.4	10 mg/Kg EPA 375.3
Chloride	5 mg/L EPA 325.2	5 mg/Kg EPA 325.2
Fluoride	5 mg/L EPA 340.2	5 mg/Kg EPA 340.2
pH*	*	*
Specific Conductance*	*	*
Temperature*	*	*

Laboratory Methods for Radionuclides are Identified in Part B of the GRRASP and in the Quality Assurance Addendum for This Work Plan.

*Field Methods OPS-GW.05 (EG&G, 1991c).

5.1.2.5 Evaluate Sampling/Analysis Options

RFI/RI data collection and analysis for OU 13 will utilize a graduated approach in which analytical Level I and Level II field screening techniques will be used to focus subsequent data collection and analysis for analytical Levels IV and V. The sampling/analysis options selected are based upon their ability to obtain data that is consistent with known site conditions. Simply stated the objective for Stage I surveys is to determine if contamination is present in the area being investigated.

Field screening techniques will be used whenever possible to reduce waste generated during sample collection, minimize delays that can result when more exacting analytical methods are used, and to minimize worker exposure. Analytical Level I and Level II field screening will assess both radiochemical and organic chemical contamination during Stage 1 of the FSAP.

5.1.2.5.1 Radiological Surveys using a High Purity Germanium detector (HPGe) or Fidler/NaI detectors will be conducted to survey 100 percent of the IHSS area in order to identify areas of radiochemical contamination on the surface and to map anomalous areas that may require further investigation. Field methods for use of the HPGe are presently being finalized and a standard operating procedure will be incorporated in the Environmental Management Radiological Guidelines Manual (RFP-EMD, 1991a). In areas where it is not practical to use the HPGe equipment, Fidler/NaI detectors will be used to ensure 100% coverage of the area surveyed. Hand held detectors will be employed for health and safety purposes and to screen the sides of buildings or other obstructions which could influence the other detectors. (More information about the use of these detectors is being developed in a paper ***Compendium of In-situ Radiological Characterization Methods and Applications*** which will be available before field work begins.)

5.1.2.5.2 Soil Gas surveys utilizing a portable GC will be used to identify areas of organic chemical contamination and to direct further sampling efforts. Data collection procedures will be those specified in Environmental Management Division Manual 5-21000, Volume III, Geotechnical (RFP-EMD, 1992a). Two grid spacings are specified—20 feet and 40 feet.

Operational data from recent soil gas surveys conducted at Rocky Flats were utilized in conjunction with a transient subsurface pressure distribution equation (Equation I) to assess the radius of influence of soil gas survey (Johnson, et al., 1990).

$$P' = \frac{Q}{4\pi m(k/\mu)}\left[-0.5772 - \ln\left(\frac{r^2\varepsilon\mu}{4kP_{atm}}\right) + \ln(t)\right]$$

where:

- P' = "gauge" pressure measured at distance r and time t
- m = stratum thickness (3 m)
- r = radial distance from vapor extraction well
- k = soil permeability to air flow (5.0×10^{-2} to 1.52×10^{-1} darcies)
- μ = viscosity of air (1.8×10^{-4} g/cm-s)
- ε = air-filled soil void fraction (0.10)
- t = time
- Q = volumetric vapor flow rate from extraction well (0.70 to 0.97 scfm)
- P_{atm} = ambient atmospheric pressure = 1.013×10^6 g/cm-s^2.

The results of this analysis indicated that a 10-foot radius of influence was achievable under the operating conditions that may be expected in OU 13. This will result in complete coverage using a 20 foot grid.

A forty foot grid is specified for IHSS where the likelihood of encountering large spills is very high based on past history. For example, Section 2.1 documents the release of approximately 700 gallons of No. 6 diesel fuel at IHSS 152 in 1971. A spill this size would be sufficient to cover an area of approximately 50 feet by 50 feet to a depth of 1/2 inch, which a forty foot grid would adequately locate. This is especially true because the area of contaminated soil would most likely be much larger.

In any event, if contamination is discovered during the soil gas survey, the sampling grid will be expanded to determine the full extent of the contamination. If the sampling effort is extended beyond the current IHSS boundary into an adjacent IHSS, discussion with the appropriate OU manager would be initiated. This will insure that the expanded sampling protocol matches the objectives specified in the relevant work plan.

5.1.2.5.3 Surficial Soils Sampling—As part of the Stage 1 sampling program, surficial soil samples will be taken at specific IHSS areas. The objective of the initial soil sampling plan is to identify elevated concentrations of possible contaminants and to augment the findings of the HPGe survey within each specific IHSS area in OU 13. These samples will be analyzed for TAL metals and a full suite of radionuclides: plutonium 239 and 240, americium 241, uranium 238, uranium 233/234, tritium, strontium 89/90, strontium 90, cesium 137, radium 226, radium 228, gross alpha and gross beta. In some cases, specific metals—lithium, beryllium and magnesium will be targeted for analysis at specified IHSSs. One sample per group will be analyzed for gamma-emitting radionuclides with onsite laboratory HPGe instruments. At specific IHSSs where radioactivity has been detected, asphalt samples will also be collected and analyzed for radioactivity with a laboratory HPGe. Laboratory analytical methods will conform to those referenced in GRRASP; these methods meet the criteria for analytical Levels IV and V. Field data collection will be in accordance with Environmental Management Division Manual 5-2000, Volume III, Geotechnical (RFP-EMD, 1992a). (An SOP for the laboratory HPGe is currently under development and will be completed and submitted for regulatory agency approval prior to use.) Sample collection will proceed according to SOP GT.08. Any specific revisions to the procedures will be approved by the regulatory agencies prior to use.

The surficial soils sampling problem is defined as detecting whether contamination is present at each specific IHSS area. The maximum concentration for each constituent will be used to determine if elevated concentrations exist. If elevated concentrations are identified, then more in-depth borehole and surficial soil sampling will be conducted in Stage 2 to characterize the contaminant and collect additional data to support a human health risk assessment.

The following is the statistical approach used to determine the number of samples to collect. Given N independent samples, the probability of observing at least one contaminated sample when contamination affects a fraction of the site, is:

$$P = 1 - (1-f)^N$$

WHERE: f = fraction of site contaminated
N = number of independent samples.

The assumptions are that at least 25 percent of the site is contaminated and the samples will be independent. Eleven samples are required to observe at least one contaminated sample with a probability of at least 95 percent within each IHSS group. IHSSs are grouped when their boundaries overlap or they are contiguous in such a manner as to present a discrete area. Table 5.5 shows which IHSSs are grouped together for sampling purposes.

Judgmental sampling, based on historical information and results from the visual and HPGe surveys, will be combined with random sampling to bias the samples to improve detection of contamination. A visual survey will be performed to identify areas where elevated concentrations of contaminants are likely to exist. The results of the visual survey and the HPGe survey will determine the location of surface soil samples. A surface soil sample will be collected at each area where contamination is most likely to exist based on historical information and the visual survey. A surface soil sample will also be collected at anomalous areas identified by the HPGe survey. The remaining surface soil samples will be randomly selected throughout each specific IHSS area using grid points from the HPGe survey. Grid intersections that are located at any of the previously determined sampling locations will be exempted from the random sampling locations.

Table 5.5

Surficial Soil Sampling IHSS Groups

IHSS Group	Number of Samples
117.1 & 197	11
117.2 & 158	11
117.3 & 152	11
148	11
157.1	11
186	11
134S up to but not including171	11
134 N & 128 & 171	11
Total	88

5.1.2.5.4 Boreholes—A limited number of boreholes will also be drilled during Stage 1 at IHSSs where subsurface release of contamination may be present at depth. The samples from these boreholes will be analyzed for TAL metals, radionuclides, and specific anions.

5.1.2.5.5 Alluvial Groundwater Sampling will continue to be collected during Stage 1 from all existing monitoring wells and piezometers in and surrounding OU 13. This data, historical data from these wells, and new data developed during Stage 1 investigations will be used to locate groundwater sampling activities in Stage 2.

5.1.2.5.6 Additional Activities—After Stage 1 sampling is complete, a technical memorandum will be prepared. The technical memorandum will evaluate the results of Stage 1 sampling and recommend locations for locating boreholes and collecting surface scrape samples. If surficial soil sampling results are not available, they will be reported in a later technical memorandum prior to the commencement of Stage 3 sampling.

Surface scrape samples will be collected during Stage 2 of the FSAP at borehole locations. If a borehole is located in a paved area, the surficial soil scrape will be taken after the pavement is removed. A sample will be taken from directly below the pavement and another taken at either four inches below the pavement bottom, or at the surface of the next soil horizon begins (roadbase/ preparation bed soil). (The SOP governing this work is currently being revised. It will be submitted to the regulatory agencies for approval prior to use in the field.) Surface scrape samples will be analyzed for TAL metals, plutonium 239 and 240, americium 241, uranium 238, uranium 235, uranium 233/234, tritium, strontium 89/90, strontium 90, cesium 137, radium 226, radium 228, gross alpha, and gross beta. Analytical methods will conform to those referenced in the GRRASP; these methods meet the criteria for analytical Level III through V. Field data collection will be in accordance with Environmental Management Division Manual 5-21000, Volume III, Geotechnical (RFP-EMD, 1992a).

Soil samples will be collected from boreholes during Stage 2 of the FSAP to assess contaminant types and distribution. For those IHSSs where no contamination was detected by Stage 1 activities, a sufficient number of boreholes will be drilled to confirm that there is no contamination.

The number of borings will be proposed in the first Technical Memorandum and will be based on IHSS size, known waste storage history, and possible below ground releases. At IHSSs where contamination was found during the screening surveys, Stage 2 will consist of at least three borings transecting each anomaly (radioactive or other contaminant) downgradient from the point of maximum contamination. This will be done for a maximum of three transects resulting in nine boreholes per IHSS.

The need for any additional boreholes can be evaluated in the Stage 2 Technical Memorandum. These additional borings, if required, will be drilled during Stage 3.

An exception to this method of locating boreholes will be made for IHSS 152. Three boreholes will be drilled around the berm surrounding the storage tank, one upgradient and two downgradient. Samples will be analyzed for TCL volatile compounds, TCL semi-volatile compounds, TAL metals, plutonium 239 and 240, americium 241, uranium 238, uranium 235, uranium 233/234, tritium, strontium 89/90, strontium 90, cesium 137, radium 226 radium 228, gross alpha, and gross beta. Analytical Level III will be used for the volatile, semi-volatile and metals analyses. Analytical Level V will be used for the radiochemical analyses. Field data collection will be in accordance with Environmental Management Division Manual 5-21000, Volume III, Geotechnical (RFP-EMD, 1992b).

Alluvial groundwater samples will be collected from all existing piezometers and monitor wells in and immediately surrounding OU 13 during stage one of the FSAP. During stage two of the FSAP, alluvial groundwater samples will be collected at the time boreholes are drilled using the Hydropunch® method or equivalent for real time and laboratory analysis. If contamination is confirmed by the soil or groundwater samples, one monitoring well will be installed upgradient of the affected IHSS and one monitoring well will be installed downgradient of the affected IHSS. Samples will be analyzed for TCL volatiles, TCL semi-volatiles, TAL metals, plutonium 239 and 240, americium 241, uranium 238, uranium 235, uranium 233/234, tritium, strontium 89/90, strontium 90, cesium 137, radium 226, radium 228, gross alpha and gross beta. Quarterly groundwater data collection from monitoring wells will be conducted as Part of the RFP site-wide monitoring program. Analytical Level IV (CLP protocol) and Level V (for radiochemicals) will be used for groundwater sample analysis. Groundwater sampling and measurement of field parameters will be conducted in accordance with procedures specified in the FSAP.

All data collection field records will be handled in accordance with the quality control procedures specified in Environmental Management Division Manual 521000, Volume I, Field Operations (RFP-EMD, 1992c).

5.1.2.6 Review of PARCC Parameter Information

PARCC parameters (precision, accuracy, representativeness, completeness, and comparability) for analytical Levels I, II, IV, and V are discussed below. Precision, accuracy and completeness goals are specified in the Quality Assurance addendum for this Work Plan.

Precision is a quantitative measure of data quality that defines the reproducibility or degree of agreement among replicate measurements of a single analyte. The closer the numerical values of the measurements are to each other, the more precise the measurements. One of methods used to estimate the precision of a method is the standard error of the estimates for the least square regression line of "measured" versus "target" concentrations (EG&G, 1991i). The primary role of this application is to characterize the precision of any analysis method under specified conditions. This allows comparison of different results produced by the same method. Analytical precision for a single analyte may be expressed as percentage of the difference between results of duplicate samples and matrix spike duplicates for a given analyte. Precision will be determined from the results of duplicate and matrix spike duplicate analyses (EG&G, 1991i).

During the collection of data using field methods or instrumentation, precision is checked by reporting several measurements taken at one location and comparing the results. Precision will be reported as the relative percent difference for two results and as the standard deviation for three or more results. Sample collection precision shall be measured in the laboratory with the analysis of field replicates and laboratory duplicates (EG&G, 1991i). Analytical precision will be achieved by adhering to the analytical methods contained in the GRRASP. Sampling precision will be achieved by conformance the procedures specified in the Environmental Management Division's Operating Procedure manuals referenced above.

Accuracy can be expressed in terms of completeness and bias. Accuracy is a quantitative measure of data quality that refers to the degree of difference between measured or calculated values and the true value. The closer to the true value, the more accurate measurement. One of the measures of analytical accuracy is expressed as a percent recovery of a spike or tracer which has been added to the environmental sample at a known concentration before analysis (ERP, 1991). While it is not feasible to totally eliminate sources of error that may reduce accuracy, the OU 13 Work Plan attempts to minimize error by using standardized analytical methods and field procedures.

Representativeness is a qualitative parameter that expresses the degree to which sample data accurately represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition (ERP, 1991). Representative data will be obtained by using both biased and unbiased methods of selecting sample locations. Biased methods will employ existing data in areas known to be contaminated to determine the degree of contamination. Unbiased methods such as grid sampling will be used to determine both the nature and extent of contamination. Field work will be conducted according to standard operating procedures, further aiding the collection of representative data.

Completeness is a quantitative measure of data quality expressed as the percentage of valid or acceptable data obtained from a measurement system. The objectives of the field sampling program are to obtain samples for all analyses required at each individual site, to provide sufficient sample material to complete those analyses, and to produce QC samples that represent all possible contamination situations such as potential contamination during sample collection, transportation, or storage (EG&G, 1991i).

Comparability is a qualitative parameter describing the confidence with which one data set may be compared to another (EPA, 1987). The standard laboratory methods of the GRRASP and standard operating procedures for conducting field work will allow for one to one comparability of OU 13 RFI/RI data to other work conducted in conformance with those same standards.

5.1.3 Stage 3 - Design Data Collection Program

Stage three of the DQO process compiles the various elements of Stages one and two into a cohesive data collection program for the OU 13 RFI/RI. To this end, a Field Sampling and Analysis Plan and Quality Assurance/Quality Control Plan have been developed and are included as Sections 6 and 10, respectively, of this Work Plan. The results of the DQO process have been distilled into a detailed list (Table 6.1) of the number and type of samples to be collected, their location, and analytical methods.

TITLE: FSAP   Approved By:

04/01/93
Effective Date

Manager   / /
Date

6.0 FIELD SAMPLING AND ANALYSIS PLAN

The purpose of this section of the work plan is to develop a Field Sampling and Analysis Plan (FSAP) that will address the data needs of the Phase I RFI/RI and describe the work required to fulfill the data quality objectives. Section 6.1 presents the objectives of the OU 13 RFI/RI. Section 6.2 summarizes site background information and rationale for the sampling, analysis, and other data collection activities. Section 6.3 discusses the field data collection program for each site. Section 6.4 describes field sampling procedures and equipment, and Section 6.5 describes the analytical program including sample designation, analytical requirements, sample containers and preservation, and sample handling and documentation. Section 6.6 describes QA/QC procedures for the OU 13 RFI/RI.

6.1 OU 13 RFI/RI OBJECTIVES

The objective of this FSAP is to provide environmental measurement data of sufficient detail and quality to meet the intended use of the data. The data generated through implementation of this FSAP will be used to:

- First, establish the presence or absence of contaminants;
- Second, characterize the environmental setting of each IHSS;
- Characterize the nature and extent of contamination;
- Third, assess fate and transport of contaminants;

- Assess risk to human health and environment;
- And finally, support selection of remedial action alternatives.

This FSAP is designed to identify, then characterize, contamination of soils and groundwater that may have resulted from historical releases at OU 13 IHSSs and at other potential areas of concern (PACs) within/or at locations identified where potential incidents of concern (PICs) are thought to have occurred near OU 13, as presented in the Historical Release Report (HRR) July 1992. Air, surface water, and sediment will be characterized using data collected under other sitewide programs unless additional data are determined to be required for these media (see Section 6.2.2).

6.2 BACKGROUND AND SAMPLING RATIONALE

6.2.1 Background

Available information regarding potential contamination associated with OU 13 includes limited IHSS histories, stratigraphic well logs, water level data, and analytical data for air, groundwater, surface water, sediment, surficial soils, and borehole samples collected within and around OU 13. This information is described in detail in Section 2.0 of this work plan.

As stated in Section 2.0, the available analytical data indicate the potential for contamination at or near several IHSSs but do not provide direct evidence of contamination. Nor is the data of a sufficient quantity or quality to allow a determination of the source(s) of contamination or the nature and extent of contamination. The existing data are currently being validated to the extent possible. The use of these data in making RFI/RI decisions will be continually evaluated as the validation process continues.

6.2.2 Sampling Rationale

The rationale for Phase I sampling activities is based on a staged approach (Table 6.1, Revised). Stage 1 will address the first objective to determine if contamination is present. It will involve primarily non-invasive screening-level surveys. Stage 2 will confirm the results of Stage 1 and verify the presence of contamination in the vadose zone and/or groundwater and begin to define the nature and extent of the contamination. Stage 3, if necessary, will address the potential migration of contaminants from each IHSS. Figures 6-1A through 6-1D present sampling decision trees for each IHSS identifying investigation stages, types of sampling, and sampling decisions. Section 6.2 presents the planned sampling activities at each IHSS. Table 6.2, compares the planned sampling activities with those required by the IAG. The procedures that will be used in each type of sampling are listed in Table 6.3 and discussed in Section 6.4.

Stage 1 sampling activities are designed to detect contamination at each IHSS primarily using non-invasive screening-level surveys. These surveys will provide an assessment of the presence or absence of contamination and they will also begin to define the nature of contamination present. They will provide information on a real-time basis that is needed for planning more detailed investigations of each IHSS. The types of activities to be conducted during Stage 1 include:

- Visual inspections;
- Surface radiological surveys;
- Soil-gas surveys;
- Soil borings (limited to IHSSs 148 and 186 where underground releases of contaminants are thought to have occurred);
- Surficial soil sampling; and
- Groundwater sampling from existing wells and piezometers.

Revised Table 6.1
(sheet 1 of 3)

Phase I Investigations for OU 13

Activity	Purpose	Location	Sample Number
Stage 1			
Visual Inspection	Identify areas of visible contamination. Assess access problems.	Entire IHSS area.	None.
HPGe Radiological Survey	Identify areas of anomalous gamma ray radiation readings.	Entire IHSS area.	IHSS dependent.
Soil Gas Survey	Locate VOC anomalies.	Entire IHSS area - grid spacing IHSS dependent.	IHSS dependent
Surficial Soil Sampling	Assess radiological and nonradiological contamination. Confirm HPGe results.	Entire IHSS area - locations IHSS dependent.	IHSS dependent.
Vertical Soil Profiles	Aid interpretation of HPGe survey.	Locations selected after HPGe survey completed.	To be determined.
Soil Borings	Assess radiological and nonradiological contamination at IHSSs where subsurface contamination may be present.	IHSS dependent.	IHSS dependent.
Asphalt/Concrete Samples	Determine the presence or absence of radionuclides.	IHSS dependent.	IHSS dependent.

Revised Table 6.1
(sheet 2 of 3)

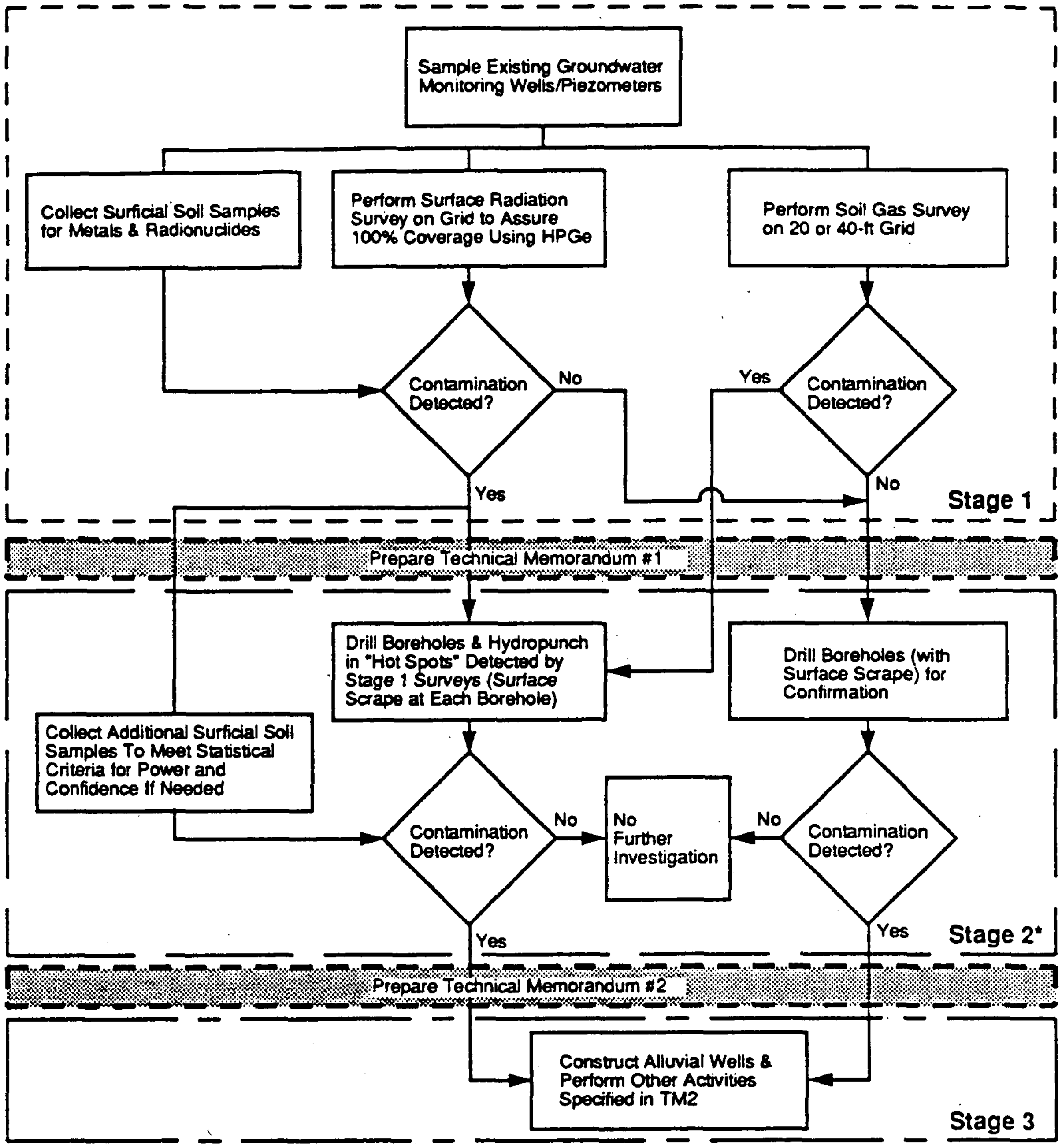
Phase I Investigations for OU 13

Activity	Purpose	Location	Sample Number
Stage 1 (continued)			
Sampling of Existing Groundwater Monitoring Wells and Piezometers	Assess radiological and nonradiological contamination. Begin characterization of groundwater conditions.	IHSS dependent.	IHSS dependent.
Sampling of Water in Sump	Assess potential contamination of surface water.	IHSS 171.	One.
TECHNICAL MEMORANDUM NO. 1			
Stage 2			
Additional Soil Samples	Provide proper statistical power and confidence if needed.		
Surface Scrapes	Determine presence/absence of contaminants at borehole locations.	IHSS dependent (at borehole locations).	To be determined.
	a. Sample anomalies identified by HPGe and soil gas surveys or confirm absence of contamination. b. Characterize subsurface vadose zone conditions and contamination.	IHSS dependent - at a minimum, one at most likely spot to be contaminated in IHSSs where no contamination was detected by screening surveys or one at the maxima detected by the HPGe and/or soil gas surveys in IHSSs where contamination was detected by screening surveys (locations to be specified in technical memorandum).	To be determined - to be specified in technical memorandum.

Revised Table 6.1
(sheet 3 of 3)

Phase I Investigations for OU 13

Activity	Purpose	Location	Sample Number
Stage 2 (continued)			
Groundwater Sampling with Hydropunch, or equivalent	Assess groundwater contamination.	IHSS dependent - at a minimum, samples to be taken in boreholes drilled at maxima detected by screening surveys (locations to be specified in technical memorandum.	To be determined - to be specified in technical memorandum.
TECHNICAL MEMORANDUM NO. 2			
Stage 3			
Soil Borings	Assessment of contaminants in subsurface.	To be determined - to be specified in technical memorandum.	To be determined - to be specified in technical memorandum.
Monitoring Well Installation and Sampling and/or Sampling with Hydropunch, or equivalent	Assess nature and extent of contamination of groundwater.	To be determined - to be specified in technical memorandum.	To be determined - to be specified in technical memorandum.
Tensiometer Nests or equivalent and Leachability Tests	Determine transport characteristics	To be determined - to be specified in technical memorandum.	To be determined - to be specified in technical memorandum.

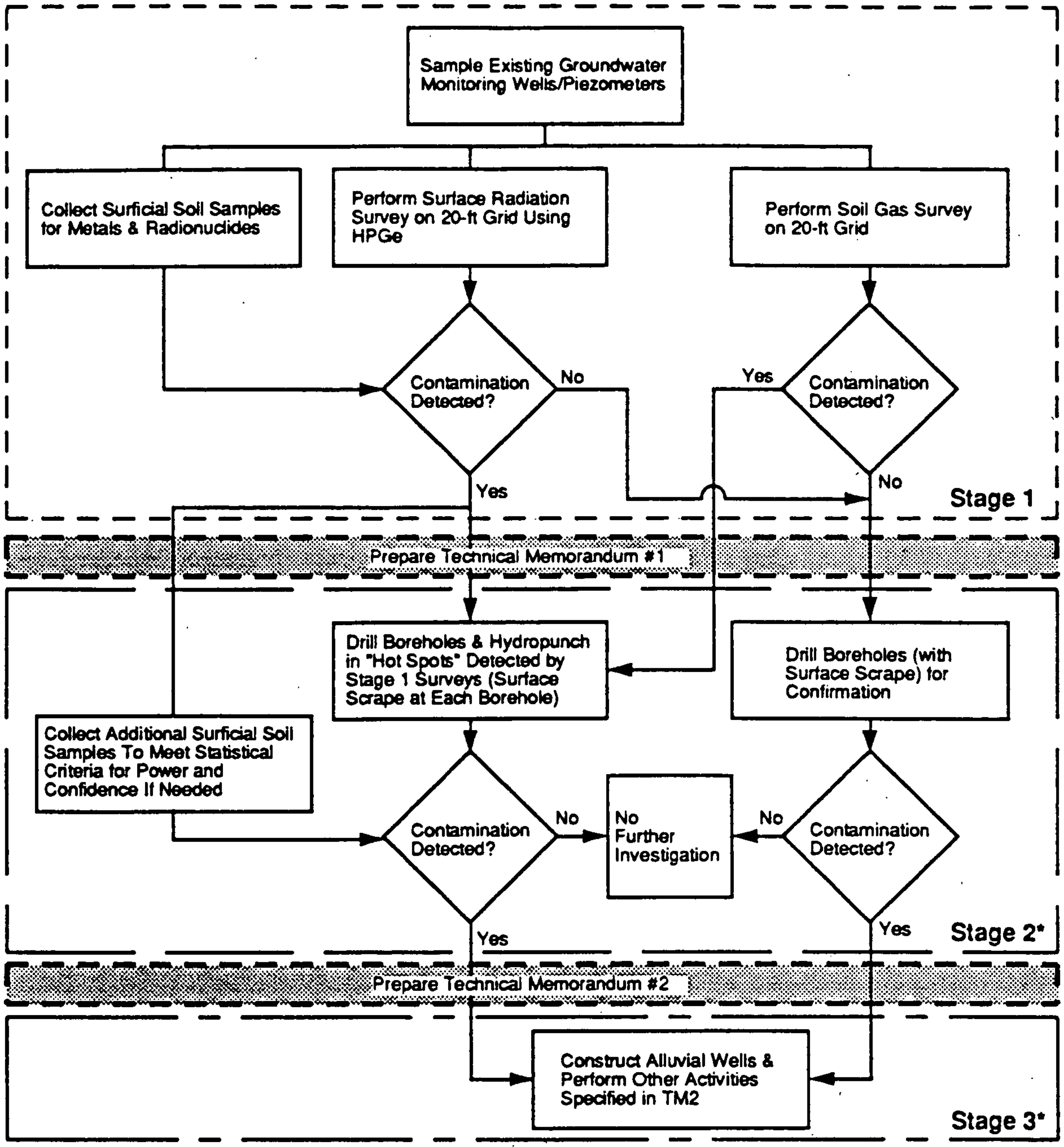


***Details regarding the Stage 2 and Stage 3 investigations will be specified in Technical Memorandums 1 and 2, respectively.**

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT

OPERABLE UNIT NO. 13
PHASE I RFI/RI WORK PLAN

REVISED FIGURE 6-1 A
Sampling Decision Tree
IHSSs 117.1, 117.2, 117.3, 128, 134, 157.1, 158, and 197

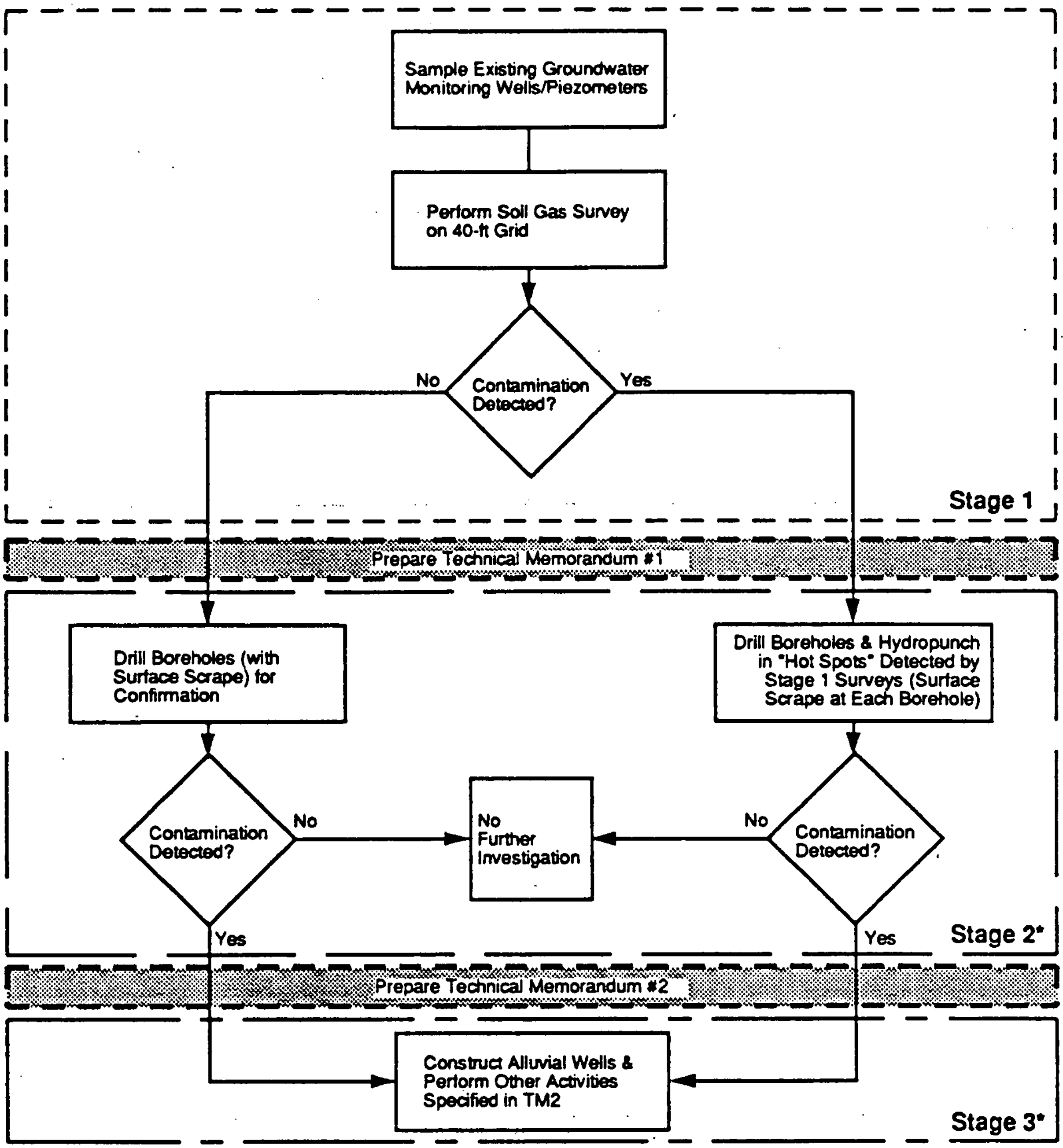


***Details regarding the Stage 2 and Stage 3 investigations will be specified in Technical Memorandums 1 and 2, respectively.**

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT

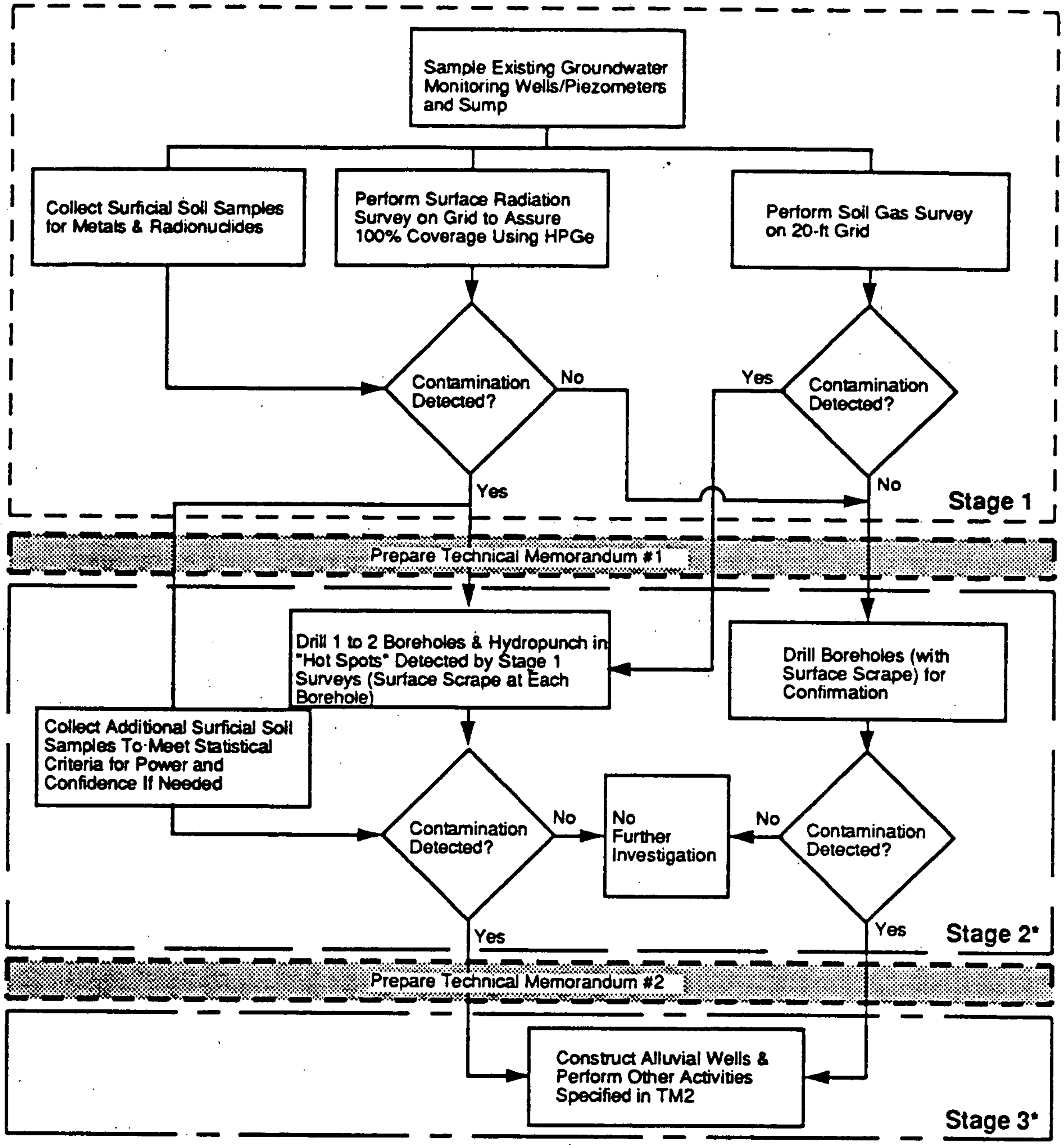
OPERABLE UNIT NO. 13
PHASE I RFI/RI WORK PLAN

REVISED FIGURE 6-1 B
Sampling Decision Tree
IHSSs 148 and 186



***Details regarding the Stage 2 and Stage 3 investigations will be specified in Technical Memorandums 1 and 2, respectively.**

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT
OPERABLE UNIT NO. 13 PHASE I RFI/RI WORK PLAN
REVISED FIGURE 6-1 C Sampling Decision Tree IHSS 152



*Details regarding the Stage 2 and Stage 3 investigations will be specified in Technical Memorandums 1 and 2, respectively.

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT

OPERABLE UNIT NO. 13
PHASE I RFI/RI WORK PLAN

REVISED FIGURE 6-1 D
Sampling Decision Tree
IHSS 171

TABLE 6.2 (Sheet 1 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
117.1	Provide documentation of materials/chemicals stored	NA	Provide documentation of materials/chemicals stored*	NA	In Agreement - Information Provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	Investigate soil contamination indicated by Well P214689 - 100% coverage
	Soil Gas Survey	100' grid spacing	Soil Gas Survey	20' grid spacing	Improved Coverage - additional analytes added based on available data
			Surficial Soil Sampling	7 (11 within IHSS group which includes IHSS 197)	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
	Boreholes (confirmatoin of soil gas)	TBD	Boreholes (confirmation of soil gas and radiation surveys)	TBD	In Agreement
	Monitoring Wells	TBD	Monitoring Wells	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined ** This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 2 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
117.3	Provide documentation of materials/chemicals stored	NA	Provide documentation of materials/chemicals stored*	NA	In Agreement - Information Provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	Investigate soil contamination indicated by Well P214689 - 100% coverage
	Soil Gas Survey	100' grid spacing	Soil Gas Survey	20' grid spacing	Improved Coverage - additional analytes added based on available data
			Surficial Soil Sampling	11	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
	Boreholes (confirmation of soil gas)	TBD	Boreholes (confirmation of soil gas and radiation surveys)	TBD	In Agreement
	Monitoring Wells	TBD	Monitoring Wells	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage

• Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined •• This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 3 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
117.2			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	Investigate possible contamination indicated by IHSS history
	Soil Gas Survey	100' grid spacing	Soil Gas Survey	20' grid spacing	Improved Coverage - additional analytes added based on available data
			Surficial Soil Sampling	6 (11 within IHSS group which inlcudes IHSS 158)	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Asphalt Sampling	5	Investigate contamination of asphalt
			Sampling Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anaomalies	TBD	In Agreement
	Boreholes (confirmation of soil gas)	TBD	Boreholes (confirmatoin of soil gas and radiation surveys)	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
	Monitoring Wells	TBD	Monitoring Wells	TBD	In Agreement

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined ** This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 4 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
128, 134, 171	Reevaluate IHSS location	NA	Reevaluate IHSS location*	NA	In Agreement - Information
			Visual Inspection	NA	Identify visible contamination
	FIDLER-GM Radiological Survey	10' grid spacing	HPGe Radiological Survey	20' grid spacing	Improved Technology
	Soil Gas Survey	25' grid spacing	Soil Gas Survey	20'grid spacing 40' grid spacing over extension of IHSS 134	Improved Coverage - additional analytes added based on available data
			Surficial Soil Sampling	8 - 171 11 - IHSS group 128, 134N, 171	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Asphalt Sampling (Southern portion of IHSS 134)	4	Investigate contamination of asphalt
			Sample Existing Wells/Piezometers	3-IHSS 128 and IHSS 171 1-IHSS 134	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
			Monitoring Wells	TBD	Increased Coverage
			Nested Tensiometers	TBD	Increased Coverage

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined •• This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 5 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
148	Submit documentation of radiometric survey(s)	NA	Submit documentation of radiometric survey(s)*	NA	In Agreement - Information provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
	FIDLER-GM Radiological Survey	10' grid spacing	HPGe Radiological Survey	20' grid spacing	Improved Technology
			Soil Gas Survey	20' grid spacing	Investigate VOC contamination of groundwater in area
			Surficial Soil Sampling	11	Confirm HPGe results
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Asphalt Sampling	4	Investigate contamination of asphalt
			Sample Existing Wells/Piezometers	5	Provide cost-effective information regarding groundwater conditions
	Soil Borings	TBD	Boreholes in Soil Gas and Radiation Anomalies and near OPWS	TBD - 1 near OPWL during stage I	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitring Wells	TBD	Increased Coverage

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined ** This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 6 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
152			Visual Inspection	NA	Identify visible contamination
	Soil Gas Survey	20' grid spacing	Soil Gas Survey	40' grid spacing	Grid spacing sufficient to find large spills documented at the IHSS
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditoins
	Soil Cores/Borings	TBD	Soil Borings	TBD - minimum of 3	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitoring Wells	TBD	Increased Coverage

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable   TBD = To be determined   ** This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 7 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
157.1	Submit documentation of radiometric survey(s)	NA	Submit documentation of radiometric survey(s)*	NA	In Agreement - Information provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
	FIDLER-GM Radiological Survey	25' grid spacing	HPGe Radiological Survey	20' grid spacing	Improved Technology 100% coverage
			Soil Gas Survey	20' grid spacing	Investigate VOC contamination of groundwater in area
	Surficial Soil Sampling	TBD	Surficial Soil Sampling	11	In Agreement
			Vertical Soil Proviles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	3	Provide cost-effective information regarding groundwater conditions
	Soil Borings	TBD	Soil Borings	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitoring Wells	TBD	Increased Coverage

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined ** This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 8 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
158			Visual Inspection	NA	Identify visible contamination
	FIDLER-GM Radiological Survey	25' grid spacing	HPGe Radiological Survey	20' grid spacing	Improved Technology 100% coverage
	Soil Gas Survey	25' grid spacing	Soil Gas Survey	20' grid spacing	Increased Coverage
	Surficial Soil Sampling	TBD	Surficial Soil Sampling	5	In Agreement
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	4	Provide cost-effective information regarding groundwater conditions
	Boreholes in Soil Gas Plumes	TBD	Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitoring Wells	TBD	Increased Coverage
169	Locate waste drum	NA	Document drum incident*	NA	Details of incident documented in Section 2.0

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined ** This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 9 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
186	Submit documentation of cleanup operations	NA	Submit documentation of cleanup operations*	NA	In Agreement - informatoin provided in Section 2.0
			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	Increased Coverage to 100%
			Soil Gas Survey	20' grid spacing	Investigate VOC contamination of soils in area
			Surficial Soil Sampling	11	Confirm HPGe results
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
	Soil Borings	TBD	Boreholes in Soil Gas and Radiation Anomalies - Boreholes along PWL	TBD - 4 boreholes along PWL	In Agreement
			Nested Tensiometers	TBD	Increased Coverage
			Monitoring Wells	TBD	Increased Coverage
190	Submit documentation regarding nature of leaks	TBD	Submit documentation regarding nature of leaks**	NA	In Agreement
191	Submit documentation regarding nature of spill	TBD	Submit documentation regarding nature of spill**	NA	In Agreement

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable TBD = To be determined ** This activity was performed during the preparation of this Work Plan

TABLE 6.2 (Sheet 10 of 10)
OU 13 IAG REQUIREMENTS*/FSP COMPARISON

	IAG*		FSP		
IHSS Number	Activity	No. of Samples/Borings	Activity	No. of Samples/Borings	Rationale
197	Originally in OU 16		Included with the investigation of IHSS 117.1 at the request of Colorado Department of Health and the Environmental Protection Agency	NA	Response to EPA and CDH requestor
			Visual Inspection	NA	Identify visible contamination
			HPGe Radiological Survey	20' grid spacing	100 % coverage - same as 117.1
			Soil Gas Survey	20' grid spacing	
			Surficial Soil Sampling	4	Investigate soil contamination with metals and radionuclides - confirm HPGe survey
			Vertical Soil Profiles	TBD	Aid interpretation of HPGe survey
			Sample Existing Wells/Piezometers	2	Provide cost-effective information regarding groundwater conditions
			Boreholes in Soil Gas and Radiation Anomalies	TBD	In Agreement
			Boreholes (confirmation of soil gas and radiation surveys)	TBD	In Agreement
			Monitoring Wells	TBD	In Agreement
			Nested Tensiometers	TBD	Increased Coverage

* Per modifications outlined in letter from G. W. Baughman, CDH, to F. Lockhardt, DOE, dated February 10, 1992.
NA = Not applicable   TBD = To be determined   ** This activity was performed during the preparation of this Work Plan

TABLE 6.3 (Sheet 1 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

IHSS	Sample Type	Applicable Standard Operating Procedures (SOPS)[1]
117.1	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
117.2	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Asphalt	Asphalt/concrete sampling SOP to be developed, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
117.3	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06

TABLE 6.3 (Sheet 2 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

IHSS	Sample Type	Applicable Standard Operating Procedures (SOPS)[1]
128	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
134	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Asphalt	Asphalt/concrete sampling SOP to be developed, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
148	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Asphalt	Asphalt/concrete sampling SOP to be developed, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Soil boring	FO.01, FO.03, FO.04, FO.08, FO.09, FO.10, FO.11, FO.12, FO.13, FO.14, FO.16, FO.18, FO.19, GT.01, GT.02, GT.03, GT.05, GT.08, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06

TABLE 6.3 (Sheet 3 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

IHSS	Sample Type	Applicable Standard Operating Procedures (SOPS)[1]
152	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
157.1	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
158	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
171	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06
	Sump Water	SW.1, SW.2, SW.3, FO.03, FO.06, FO.07, FO.10, FO.13

TABLE 6.3 (Sheet 4 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

IHSS	Sample Type	Applicable Standard Operating Procedures (SOPS)[1]
186	Radiological survey	HPGe SOP under development, FO.11, FO.14, FO.16, GT.17
	Soil gas survey	FO.01, FO.03, FO.07, FO.11, FO.14, FO.18, FO.19, GT.09, GT.17, GT.19
	Surficial soil	GT.08, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17, as in OU1 Technical Memorandum 5
	Vertical soil profile	Vertical profile SOP under development, FO.03, FO.07, FO.10, FO.11, FO.13, FO.14, GT.17
	Soil boring	FO.01, FO.03, FO.04, FO.08, FO.09, FO.10, FO.11, FO.12, FO.13, FO.14, FO.16, FO.18, FO.19, GT.01, GT.02, GT.03, GT.05, GT.08, GT.17
	Groundwater	FO.01, FO.03, FO.05, FO.07, FO.11, FO.12, FO.13, FO.14, FO.15, FO.18, FO.19, GW.01, GW.05, GW.06

TABLE 6.3 (Sheet 5 of 5)
SUMMARY OF SAMPLING PROCEDURES USED IN OU13 STAGE 1 RFI/RI

1 Standard Operating Procedures (SOPs) -

FO.01, Air Monitoring and Dust Control
FO.03, General Equipment Decontamination
FO.04, Heavy Equipment Decontamination
FO.05, Handling of Purge and Development Water
FO.07, Handling of Decontamination Water and Wash Water
FO.08, Handling of Drilling Fluids and Cuttings
FO.09, Handling of Residual Samples
FO.10, Receiving, Labeling, and Handling Environmental Materials Containers
FO.11, Field Communications
FO.12, Decontamination Facility Operations
FO.13, Containerization, Preserving, Handling and Shipping of Soil and Water Samples
FO.14, Field Data Management
FO.15, Photoionization Detectors (PIDs) and Flame Ionization Detectors (FIDs)
FO.16, Field Radiological Measurements
FO.18, Environmental Sample Radioactivity Content Screening
FO.19, Base Laboratory Work
GT.01, Logging Alluvial and Bedrock Material
GT.02, Drilling and Sampling Using Hollow Stem Auger Techniques
GT.03, Isolating Bedrock from Alluvium with Grouted Surface Casing
GT.04, Rotary Drilling and Rock Coring
GT.05, Plugging and Abandonment of Boreholes
GT.06, Monitoring Wells and Piezometer Installation
GT.08, Surface Soil Sampling
GT.09, Soil Gas Sampling and Field Analysis
GT.10, Borehole Clearing
GT.11, Plugging and Abandonment of Wells
GT.17, Land Surveying
GT.19, Field Gas Chromatographs
GW.01, Water Level Measurements in Wells and Piezometers
GW.02, Well Development
GW.05, Field Measurement of Groundwater Field Parameters
GW.06, Groundwater Sampling
SW.1, Surface Water Collection Activities
SW.2, Field Measurement of Surface Water Parameters
SW.3, Surface Water Sampling

References -

EG&G, 1991, Rocky Flats Plant EMD Operating Procedures Manual, Volume II: Groundwater, Manual No. 5-21200-OPS-GW.

EG&G, 1992, Rocky Flats Plant EMD Operating Procedures Manual, Volume I: Field Operations, Manual No. 5-21200-OPS-FO.

EG&G, 1992, Rocky Flats Plant EMD Operating Procedures Manual, Volume III: Geotechnical, Manual No. 5-21200-OPS-GT.

EG&G, 1992, Rocky Flats Plant EMD Operating Procedures Manual, Volume IV: Surface Water, Manual No. 5-21200-OPS-SW.

During all stages of the investigation, any anomalies detected will be investigated until the anomalies are completely mapped. For example, if soil gas anomalies continue beyond the present IHSS boundaries, additional soil gas samples will be collected and analyzed outside the IHSS boundaries until the anomalies are completely mapped or the boundary of a neighboring IHSS is encountered. If the adjoining IHSS is located in another operable unit, sampling within that IHSS will be coordinated with the appropriate Operable Unit Manager, to ensure that the anomalies are completely mapped.

The objectives for each of these activities are summarized in Section 5, Table 5.2.
The rationale for sampling groundwater from the existing wells and piezometers in the vicinity of OU 13 is based on the fact that the current quality of the groundwater beneath the operable unit is not known. Groundwater quality data is available for only one well located within OU 13. Sampling of the existing wells and piezometers provides a cost-effective means for better assessing groundwater conditions within the operable unit, and for analyzing the groundwater conditions that are being modeled site-wide. The data obtained from this activity will also enable a more complete evaluation of the analytical data that currently exists for these wells and piezometers in and around OU 13.

Upon completion of Stage 1, the data collected during Stage 1 screening activities will be evaluated so that subsequent stages of the investigation can be adequately planned. Results from applicable site-wide studies, Stage 1 data and recommendations for Stage 2 investigations will be summarized in a technical memorandum. Due to the turn-around times involved with obtaining laboratory results, this technical memorandum may not provide complete results of the laboratory analysis of borehole, surficial soil, and groundwater samples.

Stage 2 sampling will be used to confirm the results of the Stage 1 surveys where no contamination was found and to provide additional information on those sites where contamination was found to be present. Activities to be conducted under Stage 2 include:

- Additional surficial soil sampling (if needed);
- Surface scrape sampling (at borehole locations);

- Borehole sampling; and
- Real time sampling of groundwater using the Hydropunch®, or equivalent, technology at borehole locations.

Upon completion of Stage 2, data collected during Stages 1 and 2, and appropriate site-wide data, will be fully evaluated to determine if further investigation of each IHSS, PAC or PIC is required. The results of Stages 1 and 2 and the Stage 3 FSAP will be summarized in a technical memorandum.

Because Stage 3 relies on data collected in Stages 1 and 2, sampling needs are the hardest to predict. Stage 3 will attempt to assess if there has been migration of contamination from IHSSs determined to be sources of contamination in Stages 1 and 2. It is currently anticipated that groundwater monitoring wells will be required to assess contaminant migration. To the extent possible, existing wells and piezometers will be used. Based on the proximity of several IHSSs to one another, it is also anticipated that some wells may be used to assess contamination attributable to more than one IHSS.

More extensive methods of sampling may be required on a case by case basis. It may be possible to employ the Hydropunch®, or equivalent, technology to outline the extent of the contaminant plumes in the subsurface. It may also be necessary to evaluate possible hydraulic connection between the Rocky Flats Alluvium and the Arapahoe Formation if the borings installed during Stage 2 indicate that a porous and permeable (No. 1) sandstone subcrops beneath the alluvium near a particular IHSS(s). At IHSSs where no contamination was found during screening level activities, a sufficient number of boreholes will be drilled and sampled during State 2 to confirm that there is no contamination. The number of borings required will be based on:

- the size of the IHSS,
- inventory of waste storage at the site, and
- probability of below-ground releases.

At IHSSs where contamination was found, Stage 2 will consist of at least three borings transecting each anomaly down gradient from the point of highest concentration. A maximum of three transects (9 boreholes) will be planned for each IHSS as Stage 2 activities.

Further borehole data needed to complete characterization or locate groundwater wells will be identified in the technical memorandum prepared after Stage 2 is complete.

If the results of Stages 1 and 2 indicate the need for sampling other environmental media, such as surface water and sediments, these investigations will be implemented during Stage 3.

The applicability of vadose zone monitoring and sampling techniques in the OU 13 area will also be investigated. The results of vadose zone investigations for Operable Unit 12 and the Sewage Treatment Plant (STP) will be reviewed for applicability to OU 13. The spatial relationship of potential contamination sources to unpaved areas which can serve as conduits for infiltration and groundwater recharge will be identified in the technical memorandum prepared at the completion of Stage 2. The following methods will also be evaluated for use in that technical memorandum.

One method to measure soil moisture profiles at unpaved IHSSs is through the use of vertically-nested tensiometers or equivalent instruments. Tensiometers can be inserted by drilling small diameter boreholes either with hand augers or with a vehicle mounted hydraulic probe. Subsurface geologic conditions may limit the success of these installation methods. Transducers connected to the tensiometers produce *in situ* readings of soil-water pressure which are recorded electronically in digital form. Soil-water pressure measurements are then used to determine response of vadose zone moisture to precipitation events, and to evaluate whether soil wetting fronts reach the water table. In areas where infiltration is found to reach the water table, a potential method to be used in evaluating the mobility of contaminants present in the vadose zone is leaching tests. Leachability data are used to substantiate whether individual IHSSs are current contributors to observed groundwater contamination. SOPs do not currently exist for vadose zone monitoring and leachability testing but are developed as part of OU 4 investigations. The SOPs and some results are scheduled to be available in time to include in the Stage 2 Technical Memorandum.

6.2.3 Analytical Rationale

The potential contaminants present for each IHSS in OU 13 are listed in Table 5.3. These contaminants were identified through a review of the information provided in Section 2.0 and the Historical Release Report (July 1992). Together with the analytes specified by the IAG, these provide the basis for the analytical parameters for this investigation. However, the operational histories and release histories are not clearly defined for many of the IHSSs, and the available analytical data indicate the presence of contaminants in or near some IHSSs not known to have been released in these IHSSs. Therefore, it is necessary to utilize a more comprehensive list of analytes. The specific analytes that will be used for each stage of the Phase I RFI/RI are presented in Table 6.4 (also see Table 5.3).

Analytical results from the sampling will dictate future analytical parameters. Utilization of the parameters listed in Table 6.4 may be modified as appropriate based on additional data compilation to provide maximum potential for identifying all possible contaminants present in OU 13. Analytes for later stages will be selected based on concentration levels exceeding values identified by the Background Geochemical Characterization Report and updates to that report. Decisions regarding analytical parameter selection will be documented by submitting technical memoranda.

6.2.4 Relevant Studies of Other OUs

Current and planned investigations at other OUs may provide data relevant to the Phase I investigation of OU 13. Although areas of overlap with other OUs do not imply a reduction in scope of the Phase I investigation of OU 13, such overlaps will be examined to prevent duplication of effort. Provided that the specified objectives of the OU 13 Phase I RFI/RI are achieved, data from studies of other OUs shall be utilized to supplement or replace activities in OU 13. These determinations will be made on a case-by-case basis. Decisions regarding use of data from studies of other OUs will be documented by submitting technical memoranda.

For example, the Final Preassessment Site Investigation for the Building 374 Waste System Evaporator will provide data applicable to IHSSs 158 and 186. Surface soil samples are to be

TABLE 6.4 PHASE I, STAGE 1, ANALYTICAL PROGRAM

Parameters		IHSS 117.1 & 197	117.2	117.3	128 & 134(N)	134(S)	148	152	157.1	158	171	186
HPGe Survey [a]		X	X	X	X		X		X	X	X	X
Soil Gas Analyses [b]		X	X	X	X	X	X	X	X	X	X	X
OU13 Soil Gas Surveys												
1.1.1-Trichloroethane	IAG Required	X	X	X					X	X		
	Indicated by Available Data						X					
Dichloromethane	IAG Required	X	X	X								
	Indicated by Available Data						X			X		
Perchlorethene	IAG Required	X	X	X					X	X	X	
	Indicated by Available Data				X		X					
Trichloroethane	IAG Required	X	X	X					X	X	X	
	Indicated by Available Data						X					
Benzene	IAG Required	X	X	X	X			X		X		
	Indicated by Available Data											X
Carbon Tetrachloride	IAG Required	X	X	X						X	X	
	Indicated by Available Data											
Total Xylenes	IAG Required				X			X				
	Indicated by Available Data	X	X	X						X		X
Toluene	IAG Required				X			X		X		
	Indicated by Available Data	X	X	X								X
Carbon Disulfide	IAG Required											
	Indicated by Available Data	X			X					X	X	X
Acetone	IAG Required								X	X		
	Indicated by Available Data	X	X		X		X				X	X
Ethylbenzene	IAG Required											
	Indicated by Available Data	X	X							X		X
2-Butanone	IAG Required											
	Indicated by Available Data		X							X		
Chloroform	IAG Required								X		X	
	Indicated by Available Data						X					
1.1-Dichloroethane	IAG Required								X			
	Indicated by Available Data						X					
1.2 Dichloroethane	IAG Required									X		
	Indicated by Available Data											
Methylene Chloride	IAG Required										X	
	Indicated by Available Data											

TABLE 6.4 PHASE I, STAGE 1, ANALYTICAL PROGRAM

Parameters	IHSS										
	117.1 & 197	117.2	117.3	128 & 134(N)	134(S)	148	152	157.1	158	171	186
Surficial Soil Analyses											
TAL Metals	X	X	X		X			X	X		
Lithium				X	X					X	
Magnesium				X	X					X	
Radionuclides – Full Suite [c]	X	X	X	X	X	X		X	X	X	X
Laboratory HPGe [d]	X	X	X	X	X	X		X	X	X	X
Asphalt Analyses											
Laboratory HPGe [d]		X			X	X					
Borehole Samples											
TAL Metals						X					X
TCL Volatiles											X
TCL Demivolatiles											X
Laboratory HPGe [d]						X					X
Nitrate						X					X
Chloride						X					
Sulfate						X					
Groundwater Analyses											
TAL Metals	X	X	X	X	X	X	X	X	X	X	X
TCL Volatiles	X	X	X	X	X	X	X	X	X	X	X
TCL Semivolatiles	X	X	X	X	X	X	X	X	X	X	X
Radionuclides – Full Suite [c]	X	X	X	X	X	X	X	X	X	X	X
Anions [e]	X	X	X	X	X	X	X	X	X	X	X
Field Parameters [f]	X	X	X	X	X	X	X	X	X	X	X
Sump Liquids Analyses											
TAL Metals										X	
TCL Volatiles										X	
TCL Semivolatiles										X	
Radionuclides – Full Suite [c]										X	
Field Parameters [f]										X	

a Vertical Profile Samples Will Also Be Taken at Selected Locations for Analysis with a Laboratory HPGe
b All Soil Gas Samples Will Be Analyzed in the Field for the Constituents Listed in Section 6.3.1.1 to 6.3.1.11 for Each IHSS
c Analysis of the Following Radionuclides at a Radiochemistry Laboratory – Gross Alpha, Gross Beta, Amercium 241, Plutonium 239/240, Tritium, Uranium 233/234, Uranium 235, and Uranium 238
d Analysis of Samples for Gamma-Emitting Radionuclides with a Laboratory HPGe, or Appropriate Radiochemical Analysis
e Chloride, Fluoride, Nitrate, and Sulfate.
f Temperature, pH, and Specific Conductance

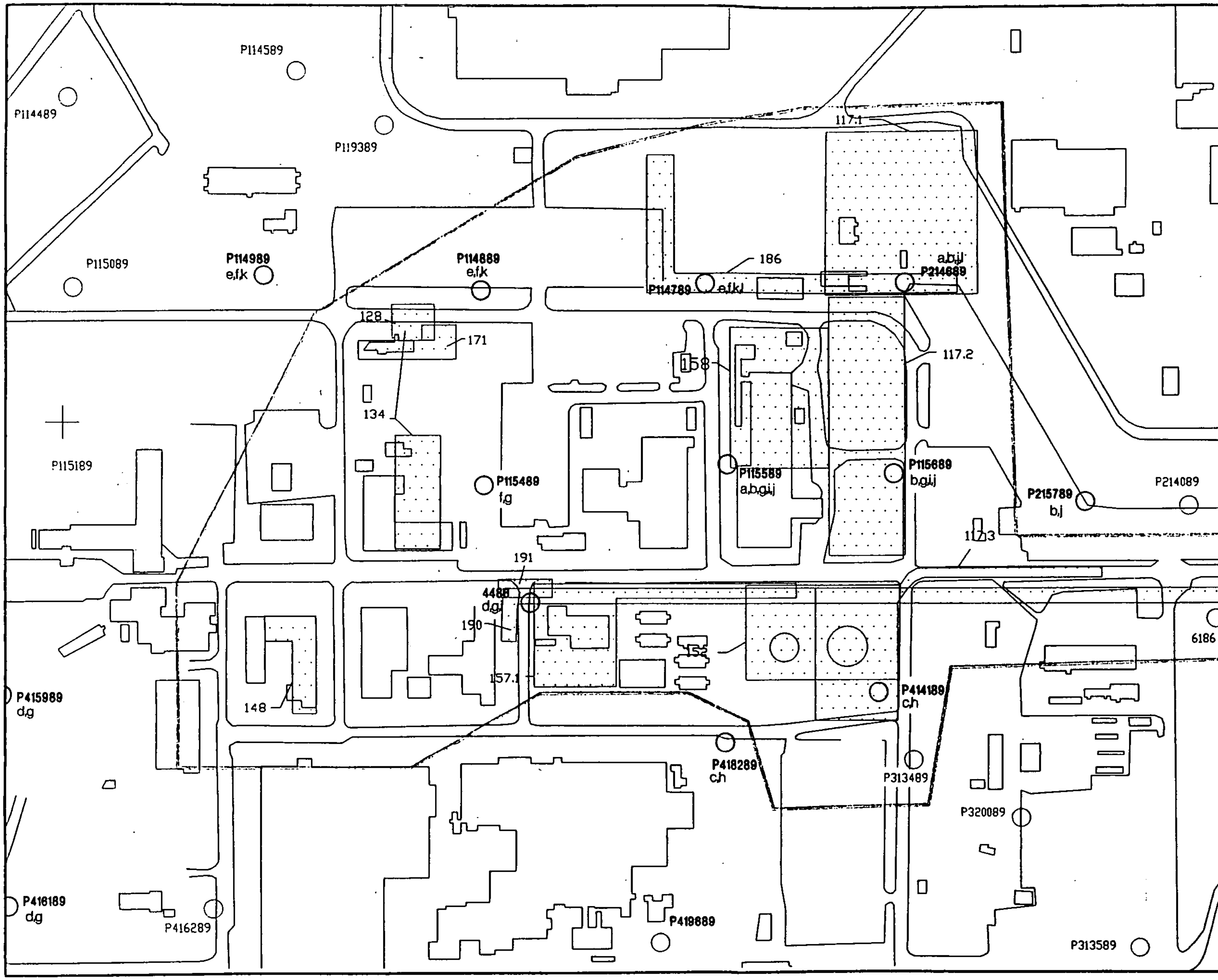
See Table 5.3 for a Complete List of Analytes, Detection Limits, and Analytical Methods collected from IHSS 158 and surface and subsurface soils are to be collected from IHSS 186 as part of this investigation. When the results of this investigation become available, they will be evaluated and presented in the technical memorandum prepared prior to Stage 2 and/or Stage 3.

6.3 SAMPLING PROGRAM

This section describes the Phase I RFI/RI investigation activities at each IHSS, PAC and/or PIC including sample locations and frequencies. The sampling programs for each IHSS are shown in Figures 6-1A to 6-1D and are described in detail in the following sections. The sampling activities and analytical program for each IHSS are summarized in Tables 6.1 and 6.4, respectively. As described in Section 2.2, it is likely that there would be no detectable impacts to environmental media as a result of the releases known to have occurred in IHSSs 190 and 191. Section 2.2 also provides information which indicates that the burial of the drum of hydrogen peroxide in IHSS 169 probably did not occur and is the same incident as that described for IHSS 191. Regardless of the potential location of this incident, it is not likely that there would be detectable impacts attributable to it. Therefore, no further investigation of IHSS 169 and IHSS 191 is proposed. That portion of IHSS 190 which includes the Central Avenue Ditch will be investigated as part of the integrated field sampling plan under development by EG&G (described in the OU 12 Work Plan). Additional investigation of PACs and PICs presented in the HRR (July 1992) are discussed in Section 6.3.1.15.

6.3.1 Stage 1 Investigation

Stage 1 sampling efforts include a visual inspection, surface radiological and soil gas surveys, limited numbers of soil borings, surficial soil sampling, vertical profile sampling, and sampling of existing groundwater monitoring wells and piezometers. Sections 6.3.1.1 to 6.3.1.14 define the details of the Stage 1 sampling program for each IHSS. In general, with the exception of sampling existing wells and piezometers, Stage 1 activities will be conducted in the order of surface radiological surveys, visual inspections, collection of surficial soil samples, soil gas surveys, and drilling of boreholes. Figure 6-2 illustrates the locations of the existing wells and piezometers to be sampled during Stage 1 and provides an indication to which IHSSs the groundwater data



OU136-2.DWG

LEGEND

INDIVIDUAL HAZARDOUS SUBSTANCE SITES
TO WHICH GROUNDWATER DATA
MAY BE APPLICABLE

a	117.1	g	148
b	117.2	h	152
c	117.3	i	157.1
d	122	j	158
e	128	k	171
f	134	l	186

191 INDIVIDUAL HAZARDOUS SUBSTANCE SITES

OPERABLE UNIT 13

4486 EXISTING WELL OR PIEZOMETER TO BE SAMPLED DURING STAGE 1

N

SCALE

0 200 400

CONTROLLED AREA

OU13

RFP BOUNDARY

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PHASE I RFI/RI WORK PLAN

FIGURE 6-2

STAGE 1
EXISTING GROUNDWATER MONITORING WELLS AND PIEZOMETERS TO BE SAMPLED

collected will be applicable. These wells and piezometers will be sampled once for the analytes specified in Table 6.4. Visual field inspection of each IHSS, PAC and PIC is necessary to identify or confirm the possible hazards such as steam pipes and overhead utilities, and to delineate paved and unpaved areas. These factors may present an opportunity to expand, or force restriction of the proposed sampling grids.

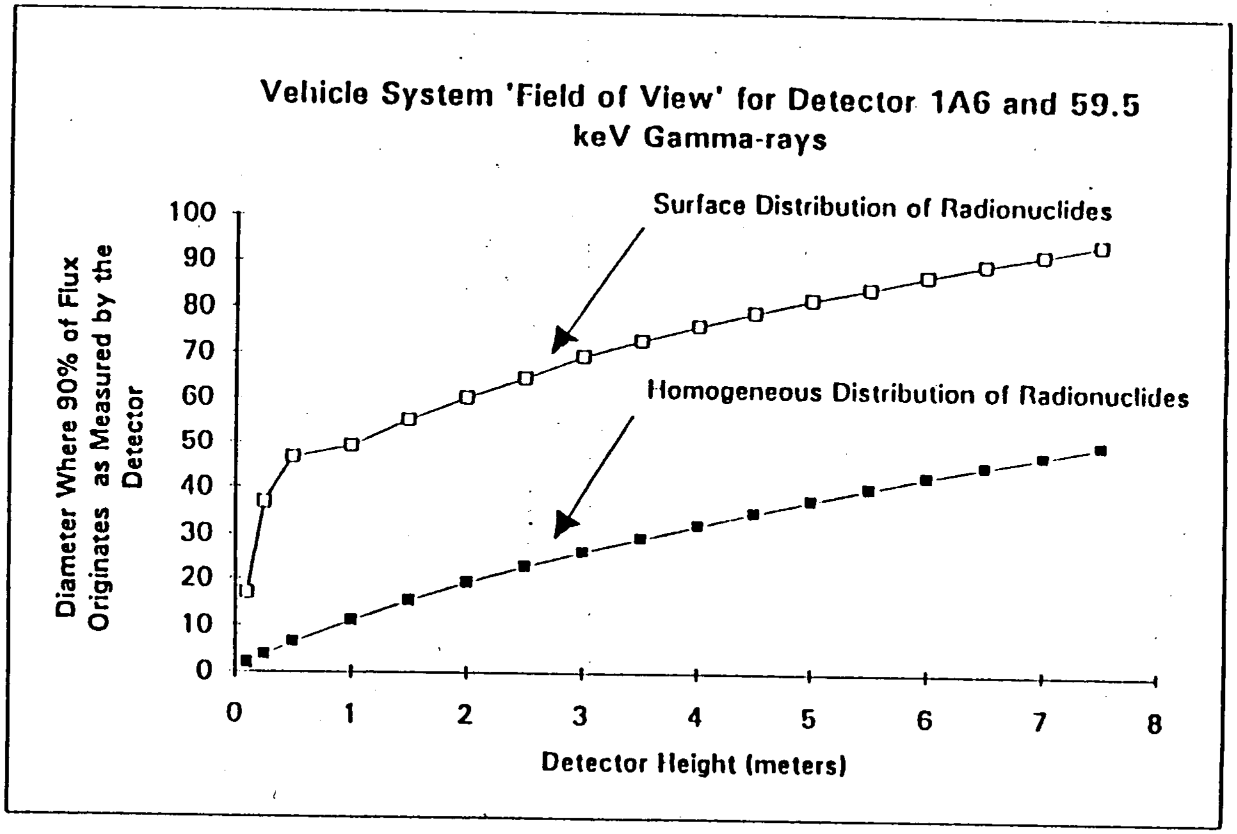
Surficial soils sampling locations need to be identified and properly biased with respect to current storage areas and stained soils and/or pavement. This field inspection can occur concurrently with the radiological survey. Eleven samples per IHSS group was determined to be statistically sufficient to detect contamination at those IHSS groups with a 95 percent probability (see Section 5.1.2.5.3).

The goal of the radiological survey is to screen 100 percent of the IHSS surface areas for radiochemical contamination. Surface radiological survey techniques will include high purity germanium (HPGe) radiological surveys supplemented with other detectors such as Fidler/NaI if needed. The HPGe detector was selected for these surveys instead of the G-M or FIDLER instruments specified by Table 5 of the IAG because the HPGe will provide greater areal coverage and higher quality results. The HPGe gamma ray detector that will be used is capable of high resolution gamma ray spectroscopy enabling the identification and quantification of gamma-emitting radionuclides. The detector is mounted on either a tripod or a vehicle. It is placed a set distance above the ground surface to measure gamma rays which originate from surface media. Table 6.5 shows the height of the detector and the size of the area that it measures. Both vehicle- and tripod-mounted HPGe instruments are currently available and in use at RFP.

The detector system integrates gamma activity over the detector's "field of view," a volume defined by which 90 percent of those gammas originating in the surface media are measured. It is assumed that radionuclide distribution is relatively homogenous over the field of view, and that the distribution varies only with depth. HPGe results are typically reported as concentration per unit mass, picoCuries per gram (pCi/g).

TABLE 6.5

Detector Height (m)	Diameter 'Field of View' (meters) Source Distribution Homogeneous	Surface
0.1	1.8	16.9
0.25	3.6	36.8
0.5	6.3	46.6
1	11.1	49.3
1.5	15.3	55.2
2	19.2	60.3
2.5	22.7	64.6
3	26	69.5
3.5	29.2	73
4	32.2	76.4
4.5	35	79.4
5	37.7	82.2
5.5	40.3	84.6
6	42.8	87.4
6.5	45.3	89.9
7	47.7	92.1
7.5	50.1	94.5



The grid size for the HPGe stations can be adjusted to provide 100 percent coverage of the area to be investigated in the most cost effective manner. For example, in wide open areas, the vehicle-mounted tripod can measure a circular area up to 51m in diameter. This can save time and lower costs. In confined, obstructed, or cluttered locations, the mast height can be reduced or a tripod-mounted detector used. The tripod grid is usually set at 20 feet (6.1m) because the detector will measure a circular area 35 feet (10.7m) in diameter when it is set one meter from the surface.

The HPGe stations are shown on a twenty foot grid in this work plan to conservatively estimate the number of stations required for 100 percent coverage. The grid will be adjusted upon the visual inspection.

Screening level activities for chemical contamination will consist of soil gas surveys and surficial soil sampling. Soil gas sampling will be conducted with a vehicle equipped with a hydraulic probing rig. This system has the advantage of allowing sampling to depths of 25 feet and extraction of soil vapor samples from discrete soil intervals without the introduction of surface air into the hole. After an access hole has been cut through concrete or pavement, if present, the rig will be set up on each sampling point. To collect a soil gas sample, the sampling probe will then be driven to a depth of 5 feet (in most cases). The retracting tip will be pulled back, and a vacuum applied to obtain the soil gas sample. The sample is to be collected with a gas tight syringe and injected directly into the gas chromatograph. The sample will be analyzed in a mobile laboratory for the analytes specified in the following sections for each IHSS and results will be obtained within minutes. The analytes specified for each IHSS include those required by the IAG and those indicated by the available analytical data presented in Section 2.0 and in the HRR. The analytes selected based on the information presented in Section 2.0 are those VOCs detected in borehole or groundwater samples from the nearest downgradient well(s) to each IHSS.

Analytical results will be presented in units of micrograms per liter (μg/L), the unit of measurement specified in EPA analytical methods references. Conversion to percentage, parts per million (ppm), or parts per billion (ppb) is dependent upon several factors, including the molecular weight of the individual compounds, air temperature, and air pressure. Detection limits for the listed analytes will be in the sub-µg/L range. Detection limits will be a function of detector type, injection volume, and specific analyte response.

Because the available historical data indicate the potential for contamination with metals at several OU 13 IHSSs, surficial soil samples will be taken during Stage 1 to determine the presence or absence of contamination. Effective field screening methods for metals in soil samples are not currently available, thus requiring that the soil samples collected be sent to a laboratory for analysis. These samples will also be analyzed for radionuclides in either an onsite laboratory with a shielded HPGe detector or a radiochemistry laboratory. This analysis will assist in augmenting the results of the HPGe survey. At sites (IHSSs 148 and 186) where the potential exists for subsurface introduction of contamination that would not be detected in surficial soil samples, drilling of soil borings will substitute for or supplement the collection of surficial soil samples. Analysis of samples in a radiochemistry laboratory will also determine the concentration of non-gamma-emitting radionuclides.

Surficial and subsurface soil samples that will be measured with a laboratory HPGe will be stored in containers for 30 days to allow radon gas to equilibrate with parent radionuclides present in the soil matrix. After 30 days, a shielded HPGE will be used to detect concentrations of gamma-emitting radionuclides in the samples.

The field sampling program described in the following sections for each IHSS provides for screening and surficial soil sampling to be initially completed on standard grids, with additional sampling points added to further define anomalous readings. The use of quick and relatively inexpensive screening methods allows the determination of general site conditions as well as the qualitative identification of contaminated areas at each IHSS. It is realized that the success of such methods is somewhat dependent on subsurface geology in the OU 13 area.

The HPGe survey is most useful at detecting radioactivity on the surface of the ground. At those IHSSs where the surface is unchanged from the time of the potential release, the area will be surveyed as described above to identify radionuclide concentrations at the surface.

In areas where the pavement may have been applied or the surface altered after the releases of interest, measurement of that radioactivity may become much more difficult. The surfacing materials block most of the gamma ray emission associated with the source below the pavement. It is likely, however, that if the source was highly radioactive, a radioactive anomaly would be detected. Therefore, two methods of investigation will help insure that anomalous areas are identified. First, results will be carefully evaluated. Then, a few random asphalt samples will be taken to compare with the HPGE readings. The asphalt samples will be taken with a plug type corer and measured with either standard radiochemical analysis or with an onsite laboratory HPGe instrument. The SOPs for both the asphalt sampling and analysis and the laboratory HPGe instrument are currently being developed. They will be submitted to the regulatory agencies for approval prior to use in the field.

The second method is to take a soil sample as part of the surficial soils sampling plan from below the pavement and have it analyzed for radionuclides. The procedure for sampling below the pavement is currently being revised and will be submitted to the agencies for their approval prior to using the procedure in the field. Basically, the pavement will be removed and a grab sample will be taken, as described in the existing SOP GT.8, of the material directly below the pavement. After that sample is taken, another sample will be taken from below any obvious roadbase or preparation bed, or 4 feet deeper, whichever occurs first. These same samples will be analyzed for TAL metals and any other IHSS-specific metals listed in the IHSS sections below.

As discussed above, minimal numbers of surficial soil and depth profile samples will be collected to augment the results of the HPGe survey. At the time surficial soil samples are collected for analysis of nonradioactive parameters, the samples collected will be split and submitted for analysis of radionuclides. At those IHSSs where surficial soil sampling programs for nonradioactive parameters are not planned, surficial soil samples will be collected for analysis of radionuclides at a subset of the HPGe stations. After the completion of the HPGe surveys, the resultant data will be analyzed and used to locate vertical profile samples.

6.3.1.1 North Chemical Storage Site (IHSS 117.1) and Scrap Metal Sites (IHSS 197)

Stage 1 sampling efforts for IHSS 117.1 and IHSS 197 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-3 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet unless conditions warrant using larger spacing for the HPGe. The analytical data available for borehole samples from well P214689, located within this IHSS, indicate that soils in the area contain above background concentrations of several radionuclides necessitating the performance of the surface radiological survey. Because the size of possible releases within this IHSS are not known, the 20-foot grid spacing for soil gas surveys will provide a conservative approach to locating contamination. Due to access and security restrictions, these investigations will not be performed within that section of the IHSS which is believed to extend into the Protected Area. This portion of the IHSS will be addressed as part of the Decommissioning and Decontamination Program at RFP. The available information regarding releases at this IHSS indicates that these releases occurred prior to the area being paved. Thus, these investigations will focus on the potential contamination of soils beneath the pavement. The portion of this IHSS that is paved will require access holes to be cut through the pavement prior to initiating these investigations. As discussed in Section 6.3.1.12, the HPGe and soil gas surveys for this IHSS will also provide information regarding releases associated with IHSS 186.

The surface radiological survey will be performed with the HPGe instruments. Fidler/NaI will be used around obstructions to confirm that they are not sources of radiation which could influence the results of the HPGe measurements. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations for analysis of TAL metals and radionuclides (Figure 6-3). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to augment the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

1,1,1-trichloroethane	perchloroethene	benzene	carbon tetrachloride
dichloromethane	trichloroethene		

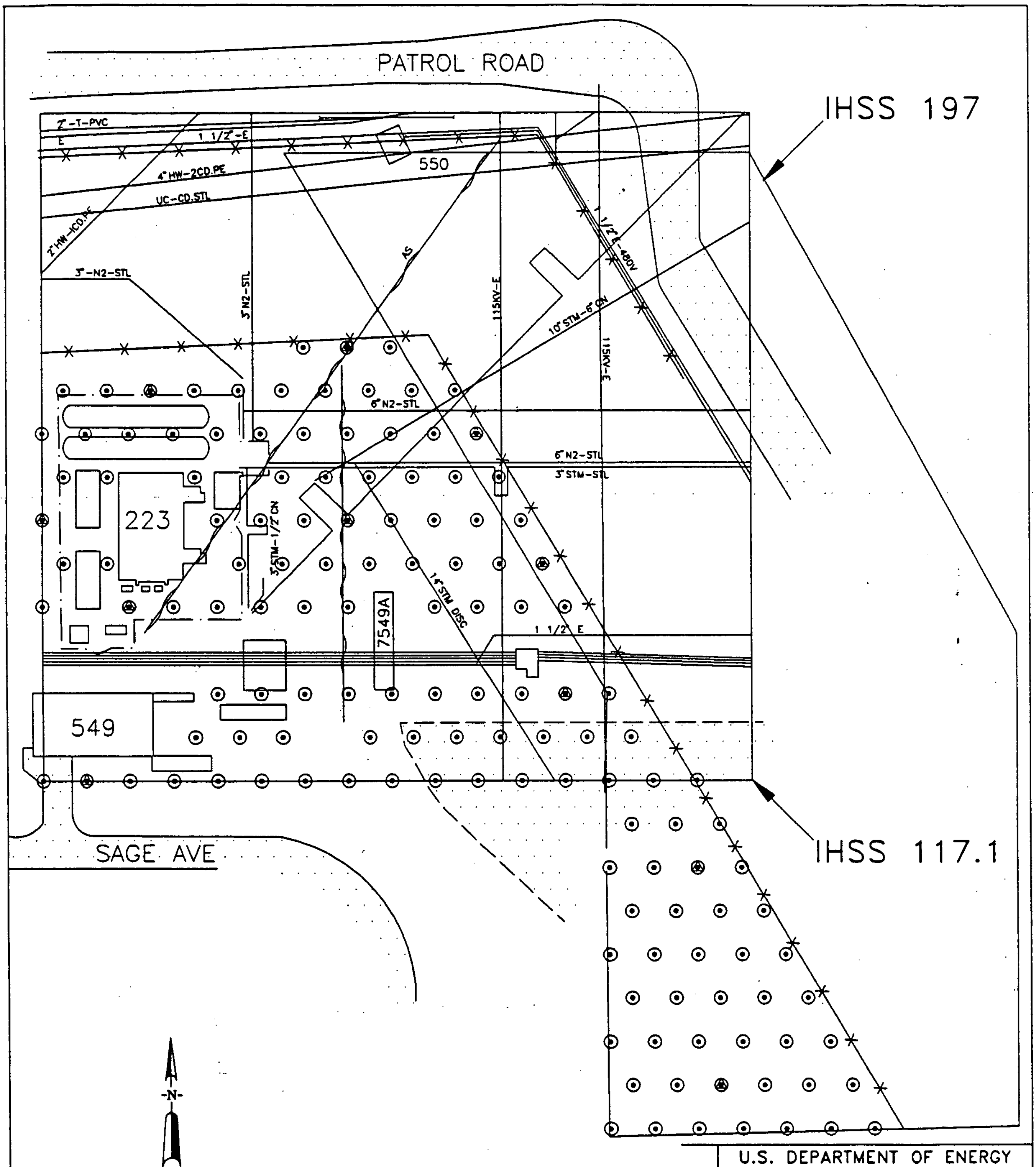
Indicated by Available Data

total xylenes	carbon disulfide	acetone ethylbenzene
toluene		

Analyses of groundwater samples from existing piezometers P214689 and P115589 will provide data which may be useful in assessing potential contamination associated with IHSS 117.1 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.2 Middle Chemical Storage Site (IHSS 117.2)

Stage 1 sampling efforts for IHSS 117.2 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-4 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. Because the size of possible releases with this IHSS are not known, the 20-foot grid spacing for the soil gas survey will provide a conservative approach to locating contamination. The available information regarding releases at this IHSS indicates that these releases occurred both before and after the IHSS was paved. Thus, the investigation of this IHSS will focus on potential contamination of the asphalt as well as the soils beneath the asphalt. The entire area of IHSS 117.2 is paved, requiring access holes be cut through the pavement prior to performing investigations of potential contamination in the soils beneath the pavement. The presence of a numerous items that are stored in this IHSS and of a large storage tent will not allow for the performance of these activities over the entire area of the IHSS (Figure 6-4). To the extent possible, stored items in this IHSS will be



0 30 60

SCALE: 1" = 60'

SCALE APPROXIMATE

0U132-3.DWG

• HPGe Station

○ Soil Gas Survey Location

△ Surficial Soil Sample

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.

Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.

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FIGURE 6-3

IHSS SAMPLING LOCATIONS
IHSS 117.1 & IHSS 197

moved around to allow for sampling. The sampling grid was adjusted to reflect these restrictions and may be adjusted again to reflect the latest information available from the visual inspections.

The surface radiological survey will initially be performed with the HPGe instrument mounted on a tripod to measure concentrations of radionuclides on the pavement surface. After the results of this survey have been evaluated, samples of asphalt will be collected at a maximum of 5 anomalous areas detected by this survey. These samples will be analyzed with a laboratory HPGe. Subsequent to this survey, surficial soil samples will be collected from eleven locations in the combined IHSS 117.2 and IHSS 158 area for analysis of TAL metals and radionuclides (Figure 6-4). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to augment the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

<u>IAG Required</u>

1,1,1-trichloroethane	perchloroethene	benzene	carbon tetrachloride
dichloromethane	trichloroethene		

<u>Indicated by Available Data</u>

total xylenes	acetone	toluene	2-butanone
ethylbenzene			

Analyses of groundwater samples from existing piezometers P214689, P115589, P115689, and P215789 will provide data which may be useful in assessing potential contamination associated with IHSS 117.2 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

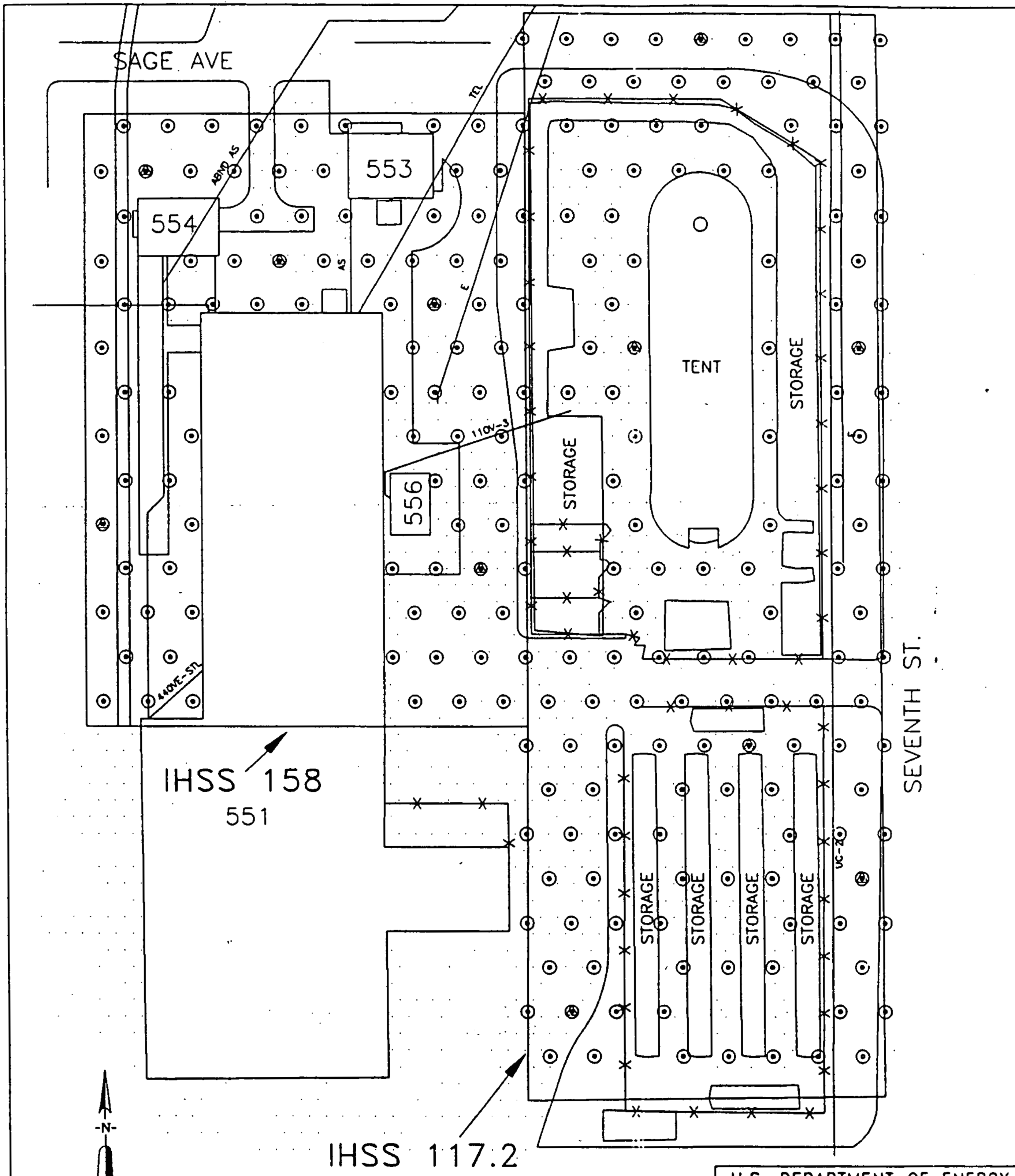

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FIGURE 6-4

IHSS SAMPLING LOCATIONS
IHSS 158 & IHSS 117.2

• HPGe Station

○ Soil Gas Survey Location

△ Surficial Soil Sample

0 30 60

SCALE: 1" = 60'

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.

Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.

OU132-5.DWG

6.3.1.3 South Chemical Storage Site (IHSS 117.3)

Stage 1 sampling efforts for IHSS 117.3 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-5 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet and 40 feet, respectively. The soil gas survey of this IHSS will be performed in conjunction with that of IHSS 152 (Section 6.3.1.7). These surveys will be conducted over the entire area of the IHSS to the extent possible. The presence of Tank 224 and equipment associated with that tank will prevent the performance of these surveys over a portion of the IHSS within the berm for that tank.

The surface radiological survey will be performed with HPGe instruments over the area of this IHSS that is outside the berm around Tank 224. Due to the fact that the area within the berm was disturbed considerably during the construction of Tank 224, it is not likely that surface contamination attributable to this IHSS would be detectable within the bermed area. Subsequent to the HPGe survey, surficial soil samples will be collected at eleven locations in the combined IHSS 117.3 and IHSS 152 area for analysis of TAL metals and radionuclides (Figure 6-5). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to augment the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey of the area of IHSS 117.3 will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

<u>IAG Required</u>

1,1,1-trichloroethane	perchloroethene	benzene	carbon tetrachloride
dichloromethane	trichloroethene		

Because IHSS 152 also occurs in the same area as IHSS 117.3 and the soil gas surveys for both IHSSs will be performed together, the soil gas samples will also be analyzed for toluene and total xylenes.

Analyses of groundwater samples from existing well P418289 and piezometer P414189 will provide data which may be useful in assessing potential contamination associated with IHSS 117.3 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

6.3.1.4 Oil Burn Pit No. 1 (IHSS 128)

Stage 1 sampling efforts for IHSS 128 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-6 and Table 6.3). These activities will also provide data required for the evaluation of the portion of IHSS 134 that occurs in this location (see Section 6.3.1.5). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. A 20-foot grid spacing was selected for the soil gas survey because the precise location of these IHSSs is not known and areas of contamination associated with them are likely to be relatively small. It is believed that these sites are located beneath the current location of Sage Avenue (Figure 6-6). It is anticipated that these surveys can be conducted between Sage Avenue and the drainage ditch to the south and the parking lot to the north. One sampling location will also be established on Sage Avenue near the center of these IHSSs. This sampling location will require that an access hole be cut through the pavement on Sage Avenue. It is estimated that approximately 10 feet of artificial fill was placed over these IHSSs during the construction of Sage Avenue. Therefore, the soil gas probe will be driven to a depth of 15 feet for sampling.

Because the location of the burn pit is of some question, the area of investigation will be expanded west to Fourth Street if no contaminated areas are found within the current IHSS boundary. If there are anomalous readings, the soil gas sampling will be expanded to clearly define the extent of contamination as described in the data quality objectives.

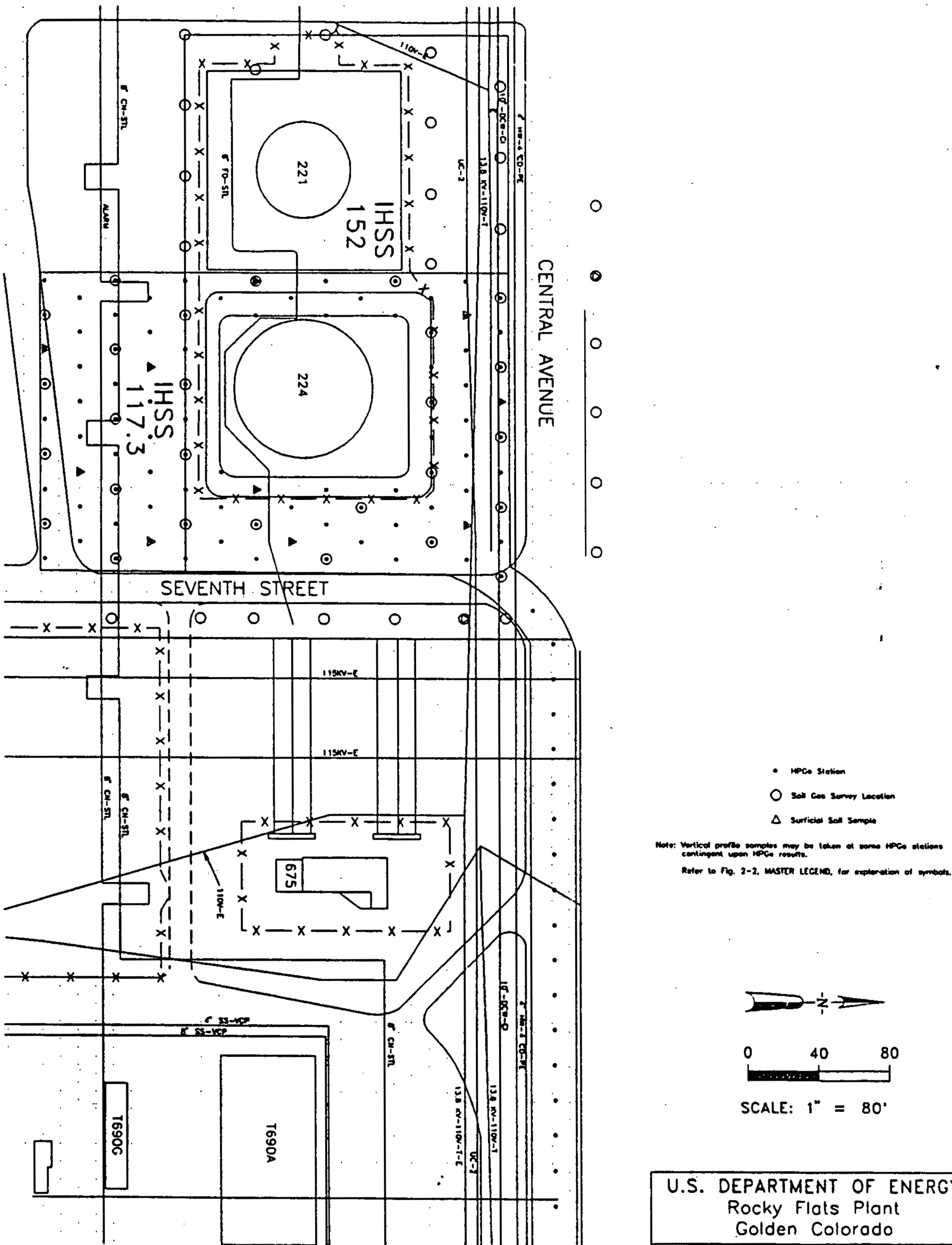

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FIGURE 6-5

IHSS SAMPLING LOCATIONS
IHSS 117.3 & IHSS 152

OU132-6.DWG

The surface radiological survey will be performed with an HPGe instrument. A sample of the soil present at the base of the artificial fill will be collected from within the boring drilled for the soil gas survey for analysis of radionuclides with a laboratory HPGe. The concentration of lithium and magnesium will also be measured. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations in the combined IHSS 128, IHSS 134N and IHSS 171 area for analysis of lithium, magnesium, and TAL metals (Figure 6-6). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

<u>IAG Required</u>

benzene	toluene	xylene	perchloroethene

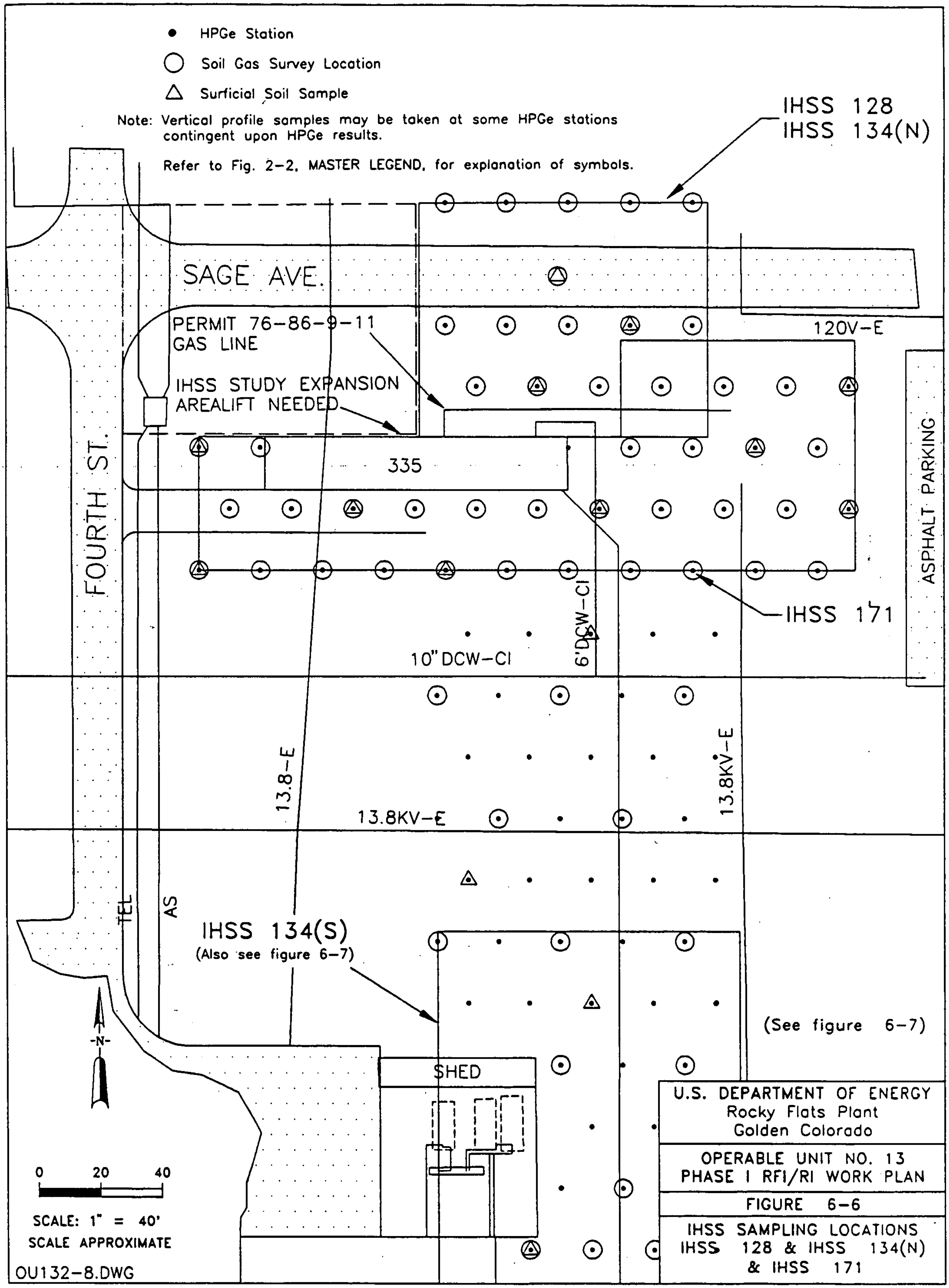
<u>Indicated by Available Data</u>

carbon disulfide	acetone

Analyses of groundwater samples from existing piezometers P114989, P114889, and P114789 will provide data which may be useful in assessing potential contamination associated with IHSS 128 and the northern portion of IHSS 134 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.5 Lithium Metal Destruction Site (IHSS 134)

As discussed in Section 6.3.1.4, the northern portion of IHSS 134 will be investigated with IHSS 128. Stage 1 sampling efforts for the southern portion of IHSS 134 will consist of a visual inspection, soil gas surveys, surficial soil sampling, and sampling of existing groundwater



HPGe Station
Soil Gas Survey Location
Surficial Soil Sample
Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.
Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.
IHSS 128
IHSS 134(N)
SAGE AVE.
PERMIT 76-86-9-11
GAS LINE
IHSS STUDY EXPANSION
AREALIFT NEEDED
120V-E
335
ASPHALT PARKING
FOURTH ST.
IHSS 171
10" DCW-CI
6' DCW-CI
13.8-E
13.8KV-E
13.8KV-E
TEL
AS
IHSS 134(S)
(Also see figure 6-7)
(See figure 6-7)
-N-
SHED
0
20
40
SCALE: 1" = 40'
SCALE APPROXIMATE
OU132-8.DWG
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FIGURE 6-6
IHSS SAMPLING LOCATIONS
IHSS 128 & IHSS 134(N)
& IHSS 171

monitoring wells and piezometers (Figure 6-7 and Table 6.3). The available information regarding releases at this IHSS indicates that these releases occurred both before and after portions of the IHSS were paved. Thus, the investigation of this IHSS will focus on potential contamination of the asphalt as well as the soils beneath the asphalt. The surveys will be conducted, as possible, from the eastern addition of Building 331 north to IHSS 171 near Building 335 and from Building 331 east to the 334 parking area (Figures 6-6 and 6-7). The soil gas survey of this IHSS will be performed on a triangular grid spacing of 20 feet from Building 331 to approximately 100 ft north of Building 331 and then will use a 40-foot spacing northward to the IHSS 171 boundary. The tighter grid spacing was selected for the area near Building 331 because most of the releases associated with this IHSS were believed to have occurred near Building 331. It is likely that the surveys of this IHSS will be performed in conjunction with the surveys of IHSS 171 (see Section 6.3.1.10). Those portions of this area that are paved will require that access holes be cut through the pavement prior to initiating investigations of potential contamination of the soils beneath the pavement.

Surficial soil samples will be collected from eleven locations in IHSS 134S and the area up to the IHSS 171 boundary for analysis of TAL metals, and lithium (Figure 6-7).

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

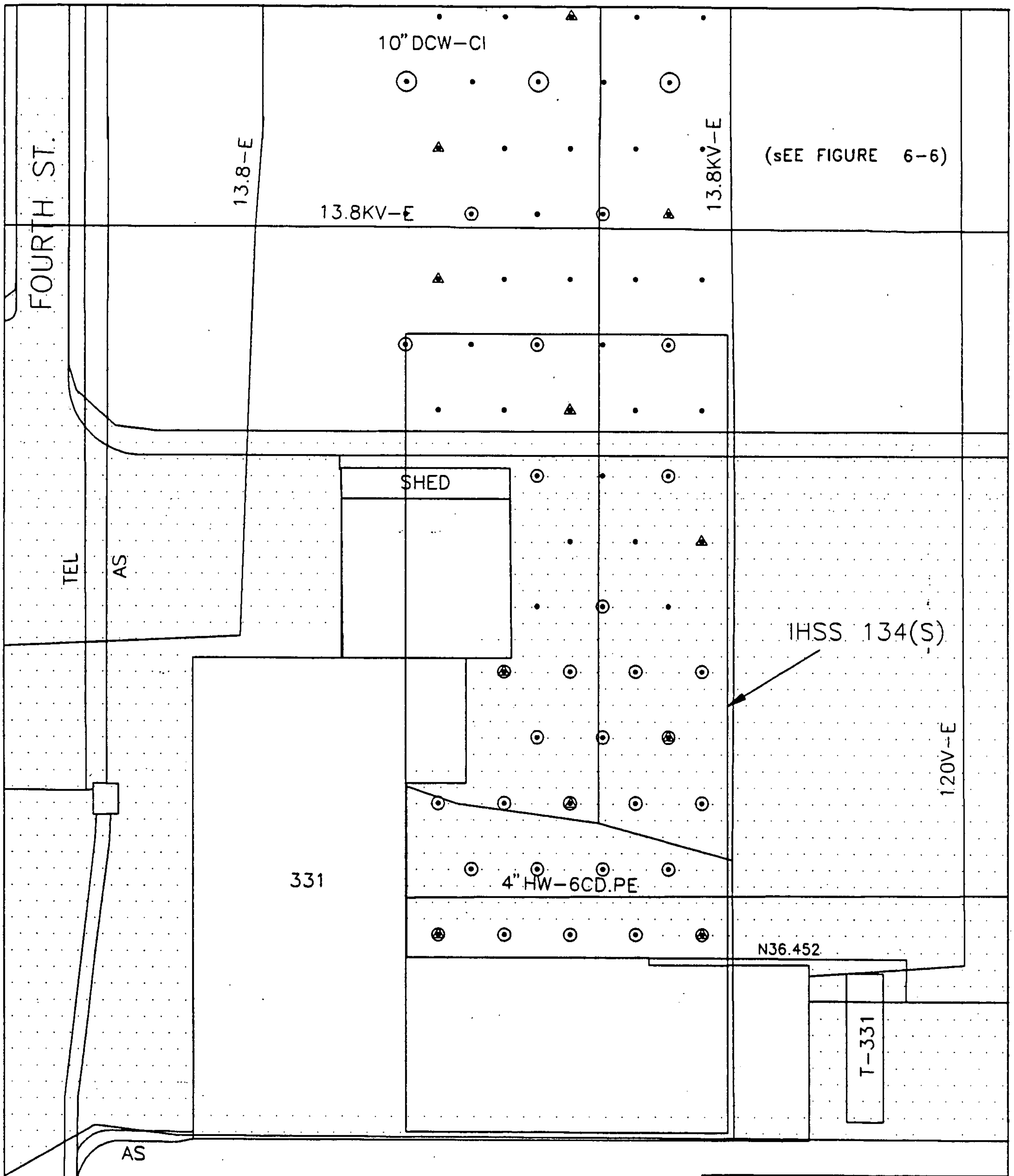
<u>IAG Required</u>

benzene toluene xylene

<u>Indicated by Available Data</u>

carbon disulfide acetone

Analyses of groundwater samples from existing piezometer P115489 will provide data which may be useful in assessing potential contamination associated with IHSS 122 (Figure 6-2). Groundwater samples from this piezometer will be analyzed for the constituents indicated in Table 6.4.



OU132–10.DWG

• HPGe Station

○ Soil Gas Survey Location

△ Surficial Soil Sample

0 20 40'

SCALE: 1" = 40'

SCALE APPROXIMATE

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.

Refer to Fig. 2–2, MASTER LEGEND, for explanation of symbols.

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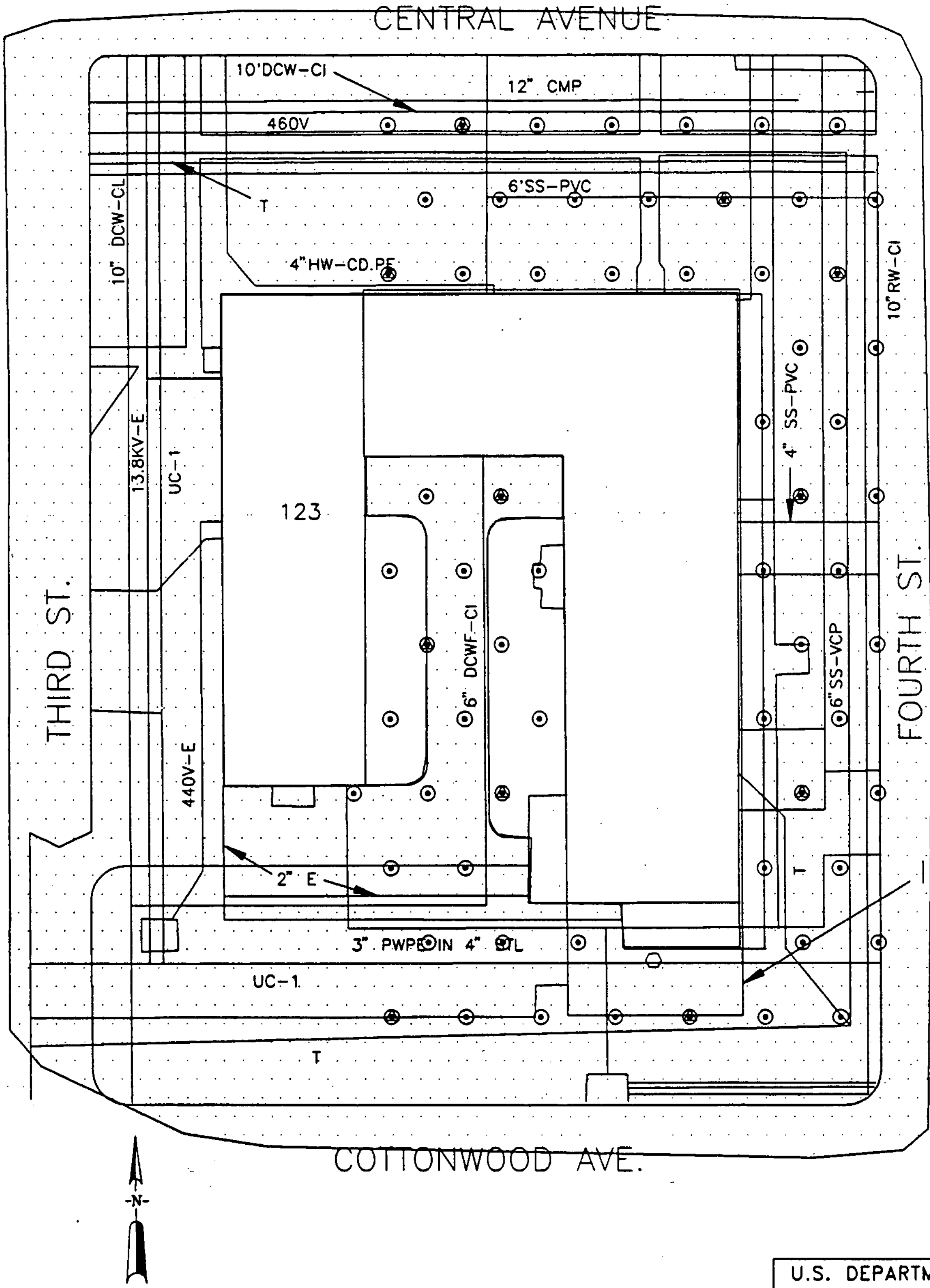
FIGURE 6–7

IHSS SAMPLING LOCATIONS
IHSS 134(S)

6.3.1.6 Waste Spills (IHSS 148)

Stage 1 sampling efforts for IHSS 148 will consist of a visual inspection, surface radiological and soil gas surveys, one soil boring, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-8 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on initial grid spacings of 20 feet. It is believed that the releases that may have occurred within this IHSS occurred primarily beneath Building 123. The available information regarding releases at this IHSS also indicate that releases may have occurred around the building perimeter before and after the area south of the building was paved. Thus, the investigation in the paved areas surrounding the building to the north, east and south will focus on potential contamination of the asphalt as well as the soils beneath the asphalt. The surface radiological and soil gas surveys will be performed around the north, east and south perimeters to a line parallel with the eastern extension of the west wing of this building. The surveys will be performed between Building 123 and Fourth Street to the east, Central Avenue to the north, and Third Street to the west. The southern side of Building 123 will be surveyed within an area extending from the building to approximately 20 feet south of the eastern wing of the building. This area includes the alcove between the wings of the building (Figure 6-8). Much of this area is paved and will require that access holes be cut through the pavement prior to initiating the investigations of potential contamination in the soils beneath the pavement.

The surface radiological survey will initially be performed with a tripod-mounted HPGe instrument over the entire IHSS area. After the results of this survey have been evaluated, samples of asphalt will be collected at a maximum of four anomalous areas detected by this survey. These samples will be analyzed with a laboratory HPGe. At eleven locations surficial soil samples will also be collected for analysis of radionuclides, TAL metals, and beryllium (Figure 6-8). Two of these samples will be split and analyzed with a laboratory HPGe. Depending on the results of the HPGe survey, vertical profile samples may also be collected.



0 20 40

SCALE: 1" = 40'
SCALE APPROXIMATE

• HPGe Station
○ Soil Gas Survey Location
△ Surficial Soil Sample
⬡ Borehole Location

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.

Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.

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FIGURE 6-8

IHSS SAMPLING LOCATIONS
IHSS 148

The IAG does not require the performance of a soil gas survey at IHSS 148. However, the available analytical data for well 4486, the nearest downgradient will to IHSS 148, indicate the presence of several VOCs in groundwater in the area. The source of these contaminants is not known, thus necessitating further investigation. The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

1,1,1-trichloroethane	perchloroethene	trichloroethene chloroform
1,1-dichloroethane	acetone	

One soil boring will be drilled adjacent to the OPWL where it exits the south side of Building 123 (Figure 6-8). The invert elevation of the pipe at this point is approximately 2.5 feet below the ground surface. The location of the pipe will be determined by examining building engineering drawings, surface geophysics, or by hand trenching along the south edge of the building. The boring will be drilled to bedrock and discrete samples will be taken as shown in Figure 6-11 and analyzed for TAL metals, beryllium, radionuclides, nitrate, chloride, and sulfate (Table 6.4).

Analyses of groundwater samples from existing well 4486 and piezometers P415989, P416189, P115589, and P115689 will provide data which may be useful in assessing potential contamination associated with IHSS 148 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

6.3.1.7 Fuel Oil Tank (IHSS 152)

Stage 1 sampling efforts for IHSS 152 will consist of a visual inspection, a soil gas survey and sampling of existing groundwater monitoring wells and piezometers (Figure 6-5 and Table 6.3). Because the releases known to have occurred within this IHSS are relatively large (i.e., hundreds of gallons), the Stage 1 soil gas survey for this IHSS will be performed on a triangular grid spacing of 40 feet (Figure 6-5). This survey will be conducted over the entire area of the IHSS to the extent possible. The presence of Tank 221 and equipment associated with the tank may prevent the performance of this survey over a portion of the IHSS within the berm for that tank (Figure 6-5). IHSS 117.3 is located within the eastern portion of this IHSS, and the soil gas surveys for both IHSSs will be performed at the same time. The survey will be performed over an area bounded by Central Avenue on the north, Sixth Street on the west, Seventh Street to the east, and Cottonwood Avenue to the south. IHSS 117.2 is located downgradient of IHSS 152. The soil gas survey proposed for IHSS 117.2 will also analyze for the compounds of interest to IHSS 152 and will provide information regarding the possible presence of contamination attributable to IHSS 152. One line of soil gas probes will also be placed between Central Avenue and Building 551 and IHSS 117.2 to the north and between Seventh Street and the electrical transformers to the east. Any further extension of the soil gas survey immediately downgradient of IHSS 152 is not feasible due to the presence of buildings and utilities. If the soil gas survey detects any contamination at the boundary of the IHSS, additional sample points will be attempted on the far side of the utilities, further downgradient.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

benzene	toluene	total xylenes

This list of compounds is based upon the requirements stated in the IAG. No historical data was obtained during the preparation of this work plan to indicate that a more extensive suite of parameters is required at this IHSS.

Analyses of groundwater samples from existing well P418289 and piezometer P414189 will provide data which may be useful in assessing potential contamination associated with IHSS 152 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

6.3.1.8 North Area Radioactive Site (IHSS 157.1)

Stage 1 sampling efforts for IHSS 157.1 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-9 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. The 20-foot spacing for the soil gas surveys was selected because releases associated with this IHSS are believed to be relatively small. The available information regarding releases at this IHSS indicates that these releases occurred prior to the area south of Building 442 being paved. Thus, the investigation of this IHSS will focus on potential contamination of the soils beneath the pavement. The surface radiological and soil gas surveys will be performed around the perimeter of Building 442 to the extent possible.. These surveys will be conducted in an area between the building and Central Avenue on the north, the sidewalk to the east, Fifth Street to the west, and extending approximately 40 feet to the south of the building in the area of Building 442 Driveway (Figure 6-9). Much of this area is paved and will require that access holes be cut through the pavement prior to initiating these surveys.

The surface radiological survey will be performed with an HPGe instrument. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations for analysis of TAL metals (Figure 6-9). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The IAG does not require the performance of a soil gas survey at IHSS 157.1. However, the available analytical data for well 4486, located in the northwest corner of the IHSS, indicate the presence of several VOCs in groundwater in the area. The source of these contaminants is not known, thus necessitating further investigation. The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

1,1,1-trichloroethane	perchloroethene	trichloroethene chloroform
1,1-dichloroethane	acetone	

Analyses of groundwater samples from existing well 4486 and piezometers P115589 and P115689 will provide data which may be useful in assessing potential contamination associated with

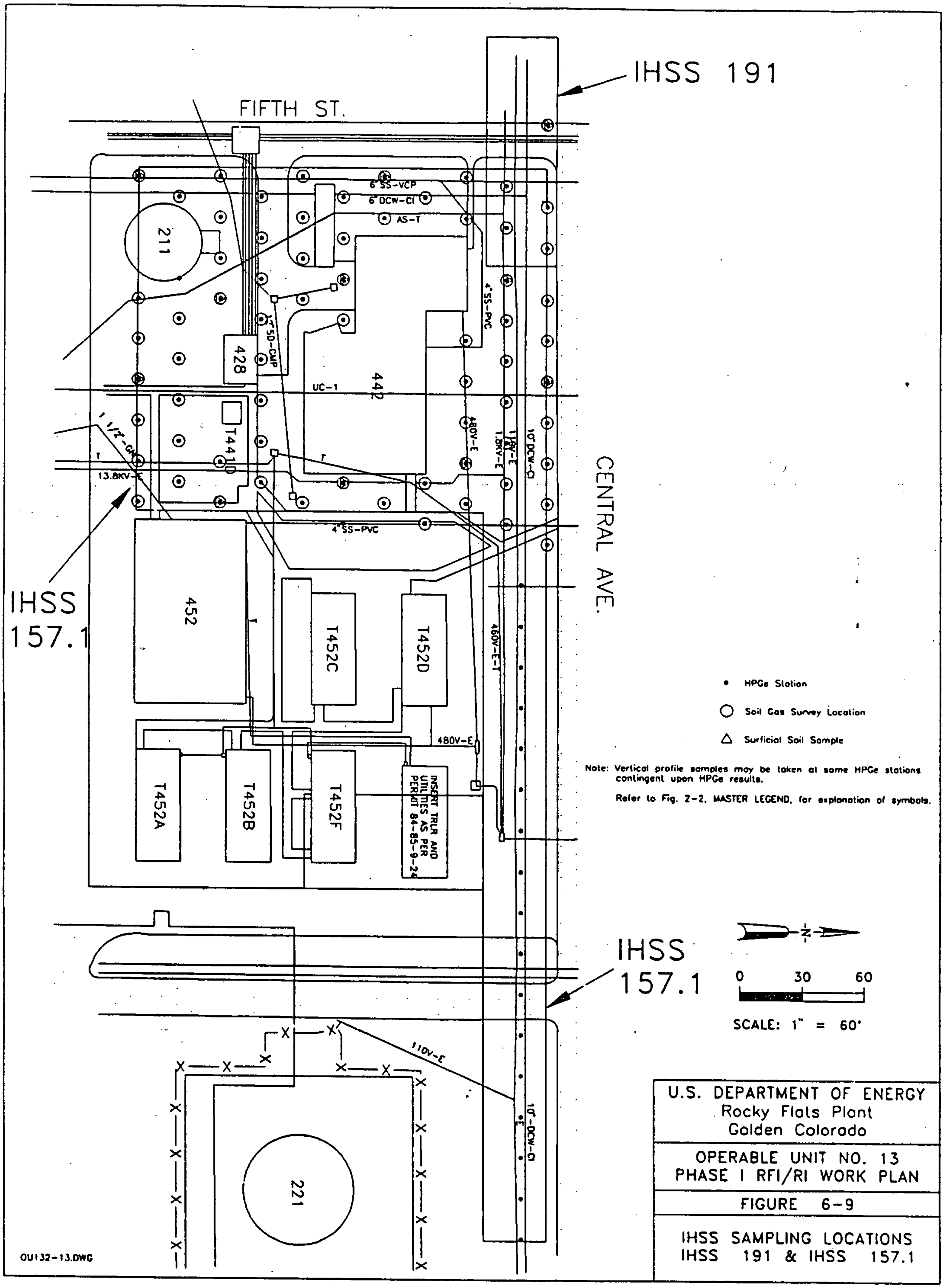

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FIGURE 6-9

IHSS SAMPLING LOCATIONS
IHSS 191 & IHSS 157.1

IHSS 157.1 (Figure 6-2). Groundwater samples from these locations will be analyzed for the constituents indicated in Table 6.4.

Samples of sediments and surface water in the Central Avenue ditch (portions of this IHSS) will be taken as part of the Integrated Surface Water and Sediment Field Sampling Plan which was conceptually approved in the OU 12 Work Plan.

6.3.1.9 Building 551 Radioactive Site (IHSS 158)

Stage 1 sampling efforts for IHSS 158 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-4 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. The grid spacing for the soil gas survey was selected because the spills and other releases associated with this IHSS are believed to be relatively small. The available information regarding releases at this IHSS indicate that these releases occurred prior to the area surrounding Building 551 being paved. Thus, the investigation of this IHSS will focus on potential contamination of soils beneath the pavement. Much of this IHSS is located beneath the northern addition of Building 551. These investigations will be conducted around the perimeter of the building to the extent possible. The area to be investigated will consist approximately of the area outside of the foundation of Building 551 from the junction between the original building and the northern addition north to Sage Avenue and from Sixth Avenue on the west side of the building to IHSS 117.2 east of the building (Figure 6-4). Much of the area north and east of the building is paved and will require holes cut through the pavement prior to initiating these surveys. In addition, the presence of several trailers and loading docks on the western side of the building necessitate that the survey grids be adjusted to maximize the coverage of the surveys in those areas.

The surface radiological survey will be performed with a tripod-mounted HPGe. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations in the combined IHSS 117.2 and IHSS 158 area for analysis of TAL metals and radionuclides (Figure 6-4). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

1,1,1-trichloroethane, perchloroethene, acetone, trichloroethene, toluene, benzene, carbon tetrachloride

Indicated by Available Data

ethylbenzene, 2-butanone, carbon disulfide, dichloromethane, total xylenes

Analyses of groundwater samples from existing piezometers P115589, P115689, P214689, and P215789 will provide data which may be useful in assessing potential contamination associated with IHSS 158 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.10 Waste Drum Peroxide Burial (IHSS 169)

As discussed in Sections 2.2.1.10 and 6.3, the documentation obtained during the preparation of this work plan indicates that the release described as IHSS 169 did not occur in the location previously indicated but is the same as IHSS 191. Regardless of the location of this incident, it is not likely that there would be detectable impacts attributable to it. Therefore, no further investigation of IHSS 169 is proposed.

6.3.1.11 Solvent Burning Ground (IHSS 171)

Stage 1 sampling efforts for IHSS 171 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, sampling of the sump within the IHSS, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-6 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. The grid spacing selected for the soil gas survey is based upon the relatively small size of areas of contamination expected to be associated with this IHSS. The area to be investigated will extend from Fourth Street east to the driveway to Building 331 and from Sage Avenue south approximately 100 feet to the base of a small slope to connect with the investigations of the southern portion of IHSS 134 (see Section 6.3.1.5). The surface of this area has not been paved and should not pose significant problems to the performance of these investigations.

The surface radiological survey will be performed with a tripod-mounted HPGe instrument over the entire area. Subsequent to the HPGe survey, surficial soil samples will be collected from eleven locations in the combined IHSS 134N, IHSS 128 and IHSS 171 area for analysis of radionuclides, lithium, and magnesium (Figure 6-6). At one of these sampling sites, a surficial soil sample will also be collected for analysis of radionuclides with a laboratory HPGe to confirm the results of the HPGe survey. This sample will be split and sent to a radiochemistry laboratory for analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

IAG Required

1,2-dichloroethane	perchloroethene	trichloroethene chloroform
carbon tetrachloride	methylene chloride	

<u>Indicated by Available Data</u>

carbon disulfide acetone

As discussed in Section 2.1.1.11, an open sump located within IHSS 171 has contained standing water with an oily sheen on its surface during several site visits from November 1991 to March 1992. If water is present in the sump, the water will be sampled and analyzed for TCL volatiles and semivolatiles, TAL metals, and radionuclides (Table 6.4).

Analyses of groundwater samples from existing piezometers P114989, P114889, and P114789 will provide data which may be useful in assessing potential contamination associated with IHSS 171 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.12 Valve Vault (IHSS 186)

Stage 1 sampling efforts for IHSS 186 will consist of a visual inspection, surface radiological and soil gas surveys, surficial soil sampling, two soil borings, and sampling of existing groundwater monitoring wells and piezometers (Figure 6-10 and Table 6.3). The Stage 1 surface radiological and soil gas surveys for this IHSS will be performed on triangular grid spacings of 20 feet. Although the area potentially affected by the releases associated with this IHSS was relatively large, considerable excavation of soils in the area has occurred in response to these releases. Thus, the remaining contamination, if it occurs, may occur in smaller areas necessitating the smaller grid spacing selected for the soil gas survey. The area to be surveyed will extend from the Protected Area south to Valve Vault 13 and then east to connect with IHSS 117.1 (Figure 6-10). The area to be surveyed is unpaved and should not pose significant problems to the performance of these surveys with the exception of adjustments in grid spacing to account for the valve vault, Building 231, and utilities in the area. The portion of this IHSS that extends into the area covered by IHSS 117.1 will be surveyed, both surface radiological and soil gas, under the planned program for IHSS 117.1 (Section 6.3.1.1). The Stage 1 investigation of IHSS 186 will not extend into the Protected Area. If the results of Stage 1 indicate that sampling within the Protected Area is necessary, a sampling program will be developed for implementation during Stage 2, or that portion of the IHSS will be transferred into a Protected Area investigation.

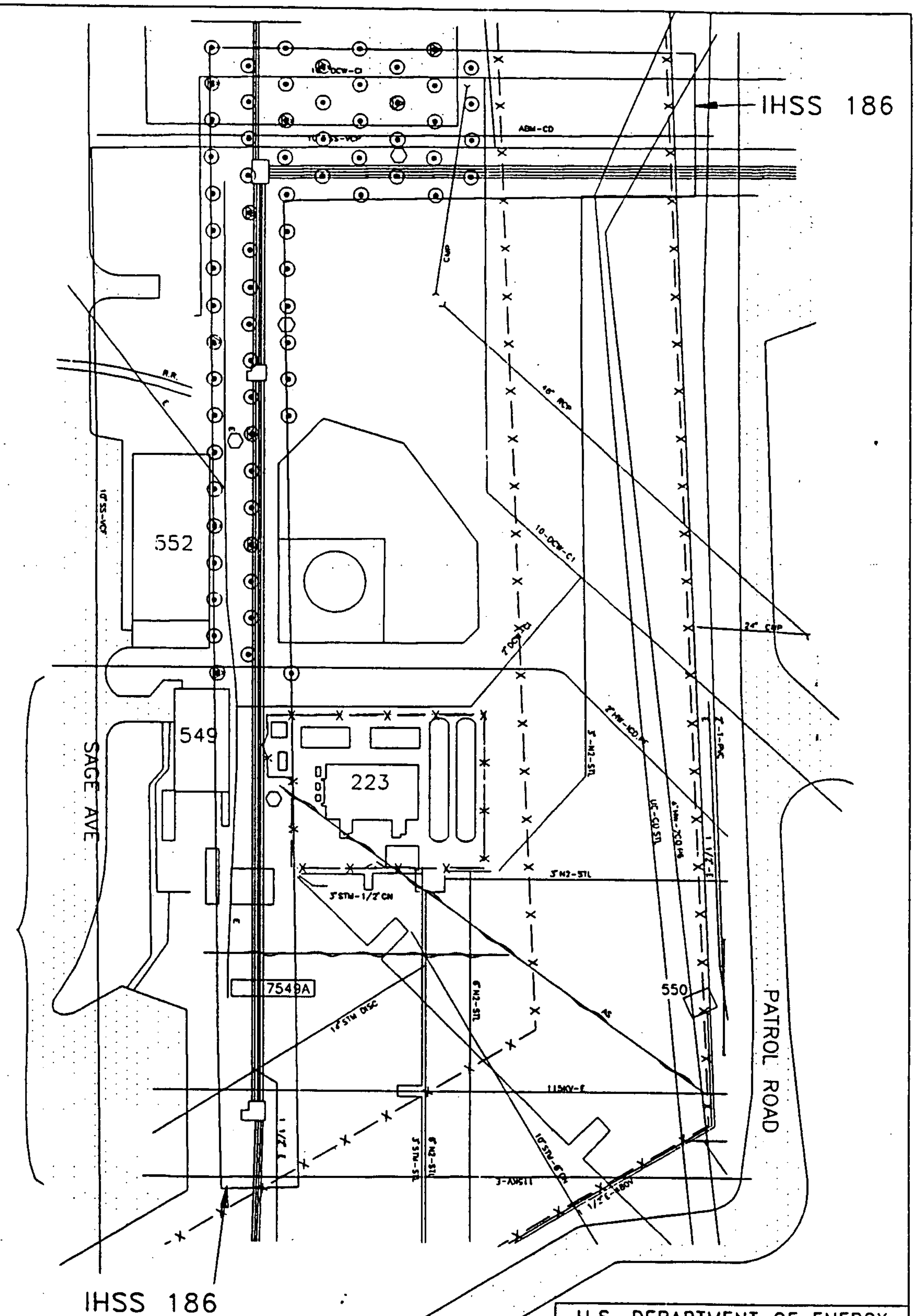
The surface radiological survey will be performed with a tripod-mounted HPGe instrument over the entire area. At eleven locations, a surficial soil sample will also be collected for analysis of radionuclides and TAL metals (Figure 6-10). Two of these samples will be split and sent for laboratory HPGe analysis. Depending on the results of the HPGe survey, vertical profile samples may also be collected.

Soil borings will be located and drilled to bedrock. Sampling intervals are displayed in Figure 6-11.

The IAG does not require the performance of a soil gas survey at IHSS 186. However, the available analytical data for well P114789, located near the southern edge of the IHSS, indicate the presence of several VOCs in soils in the area. The source of these contaminants is not known, thus necessitating further investigation. The soil gas survey will analyze for the following compounds and will note any other compounds which were detected but not calibrated for:

benzene	carbon disulfide	ethylbenzene	toluene
total xylenes	acetone		

Two soil borings will be drilled adjacent to the process waste lines in the area believed to have been contaminated by releases around Valve Vault 12 (Figure 6-10). One boring will be located between Valve Vault 12 and the retaining wall around Tanks 231A and 231B where the 1986 release was first detected. The other boring will be located approximately 18 feet west of the valve vault near the edge of an area believed to have been excavated in response to the 1986 release. Additional borings during Stage 2 will be placed between Valve Vault 13 and the Protected Area and east of Valve Vault 12 between Buildings 223 and 549. All borings will be drilled to bedrock. Each boring will be sampled in accordance with the specifications provided in Section 6.3.2 for Stage 2 borings with the following exceptions. Composited samples will also be analyzed for



• HPGe Station

○ Soil Gas Survey Location

△ Surficial Soil Sample

⬡ Borehole Location

Note: Vertical profile samples may be taken at some HPGe stations contingent upon HPGe results.

Refer to Fig. 2-2, MASTER LEGEND, for explanation of symbols.

0 40 80

SCALE: 1" = 80'

SCALE APPROXIMATE

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FIGURE 6-10

IHSS SAMPLING LOCATIONS
IHSS 186

nitrate. Analysis of radionuclides in samples from these borings will be performed onsite with a laboratory HPGe.

Analyses of groundwater samples from existing piezometers P114789 and P214689 will provide data which may be useful in assessing potential contamination associated with IHSS 186 (Figure 6-2). Groundwater samples from these piezometers will be analyzed for the constituents indicated in Table 6.4.

6.3.1.13 Caustic Leak (IHSS 190)

As discussed in Sections 2.2.13 and 6.3, it is unlikely that any impact attributable to releases within this IHSS would be detectable. Therefore, the only investigation of this IHSS proposed in this Work Plan, is that the Central Avenue Ditch, which is included in a portion of this IHSS, will be investigated within the Integrated Surface Water and Sediment Field Sampling Plan described in the OU 12 Work Plan. This plan will be incorporated into the Work Plan for Operable Unit No. 12 as a technical memorandum. Results from investigations outlined in the Integrated Surface Water and Sediment Field Sampling Plan will be addressed in the technical memorandum prepared at the end of Stage 2, and the results will be incorporated into the OU 13 RFI/RI report.

6.3.1.14 Hydrogen Peroxide Spill (IHSS 191)

As discussed in Sections 2.2.14 and 6.3, it is not likely that there would be detectable impacts attributable to the release of hydrogen peroxide within this IHSS. Therefore, no further investigation of this IHSS is proposed.

6.3.1.15 HRR PACs and PICs

This section reflects the incorporation of investigations arising from the information presented in the HRR (July 1992).

100-602, 100-603— These areas are clearly within OU 13 IHSS #148. Section 6.3.1.6 already identifies several field activities that will provide substantial information about these areas. These include surface radiological analysis with the HPGe, soil gas analysis for VOCs, and a soil boring adjacent to the Old Process Waste Line (OPWL) where it exits the south side of the building. Discrete samples will be taken at specified depths (see Figure 6-11) for analysis. Analytes will include TAL metals, radionuclides, nitrates, chlorides, and sulfates. If contaminates are found a second stage of sampling will be proposed in a Technical Memorandum (TM) to determine the nature and extent of the contamination.

100-611— This area is the site of a spill of several hundred gallons of acid scrubbing solution which was reported to have spilled into a containment area and 3 pits beneath Building 123. Because the spill occurred beneath the building and there is no direct evidence to support the contention that the leak may not have been contained as described in the HRR, no further Stage 1 investigations are planned. However, if Stage 1 investigations indicate that the area around the foundation of the building needs further investigation, addition soil borings will be scheduled in Stage 2 or 3.

100-607, 100-608, 300-709, 400-800, 500-904— These are reported as small leaks of PCBs from electrical transformers around the industrial area in the general vicinity of OU 13. Only 500-904 is actually in an OU 13 IHSS -- IHSS 117.1. All of these PCBs locations are well documented in EG&G Rocky Flats Environmental Management Department Assessment of Potential Environmental Releases of Polychlorinated Biphenyls (PCBs) July 1991. These are currently outside the scope of the present work plan and IAG. Further investigation will require substantial resources. Those PCB locations not associated with a current OU 13 IHSS will be addressed as part of a sitewide PCB remediation strategy.

Because the location of the contamination at PCB location 500-904 is known and is located within IHSS 117.1, the next step in the process will be to define the nature and extent of the contamination. The information presented in the above referenced report will be reviewed and the findings incorporated into Technical Memorandum 1 to outline appropriate activities in Stage 2.

100-609—Possible releases of dioxins and furans from the Security Incinerator in Building 123. It is likely that if there were generation of dioxins and furans from the combustion of No Carbon Required (NCR) paper, that these contaminants were released as smoke (i.e. aerosol sized particles) and are not likely to be found in detectable quantities down wind of the incineration point. If the incinerator is still intact in Building 123, an effort will be made to confirm or refute the sampling that took place in 1985. If no results can be obtained, then sampling could be either incorporated into the Decontamination & Decommissioning Plan for that building or incorporated into Stage 2. In either case the search for the data will be a Stage I activity and the results of that search reported in the Technical Memorandum.

300-702—A small building NW of the T371 complex used to store pesticides and herbicides from 1952 until 1985. Not enough information is presented in the HRR to cause this site to become an IHSS. Further investigations will be conducted as part of the Integrated Field Sampling Program for Sediments and Surface Water described in the OU 12 Work Plan. Confirmation of the possible soils contamination will be performed if the 1988 sampling records can not be found. A few sediment samples taken from the ditches near the site would be sufficient to determine if the contamination (if present) poses any human health risk. An exact number of samples and a map showing the location of the sampling points will be included in the Integrated Surface Water and Sediment Field Sampling Program and the results reported in the appropriate Technical Memorandum.

PIC #9—Possible contamination of the ground near Building 551 with aqueous ammonia and carbon tetrachloride. Sampling activities in IHSS 158 already include soil gas investigations for carbon tetrachloride. This will be sufficient to detect any sizable spill within the area. A small aqueous ammonia spill is not likely to be detected this many years after release and would pose little, if any, risk to workers or the public at this time. Therefore the proposed sampling described in the work plan is sufficient to address concerns.

6.3.2 Stage 2 Investigation

Upon completion of Stage 1, the data collected during the screening surveys and measurement of radionuclides will be evaluated and presented in a technical memorandum. This technical memorandum will provide the details of the Stage 2 investigation. The Stage 2 investigation will be performed to confirm the results of Stage 1 and to further define any contamination detected during Stage 1. Stage 2 will consist of the drilling of boreholes at locations indicated by Stage 1 screening surveys. Because of the turn-around time involved with obtaining results of the laboratory analyses of surficial soil samples, not all borings may be drilled during Stage 2.

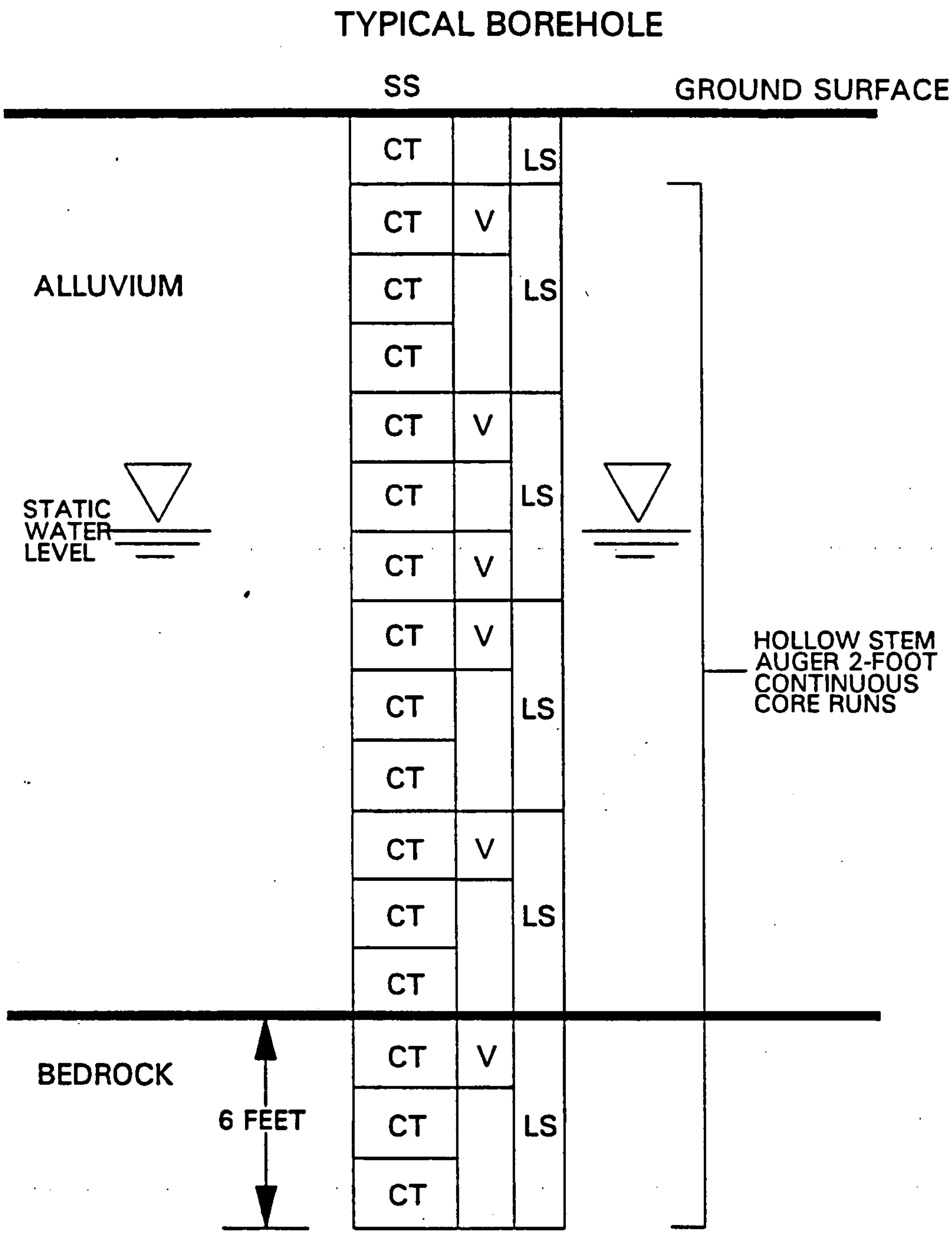
For those IHSSs where no contamination was detected by Stage 1 activities, a sufficient number of boreholes will be drilled to confirm that there is no contamination. The number of borings will be proposed in the first Technical Memorandum and will be based on IHSS size, known waste storage history, and possible below ground releases.

At IHSSs where contamination was found during the screening surveys, Stage II will consist of at least three borings transecting each anomaly (radioactive or other contaminant) downgradient from the point of maximum contamination. This will be done for a maximum of three transects resulting in nine boreholes per IHSS.

The need for any additional boreholes can be evaluated in the Stage 2 Technical Memorandum. These additional borings, if required, will be installed during Stage 3.

Three borings will be drilled around Tank 221 in IHSS 152 in order to delineate contamination that has resulted from releases that have occurred. The locations of these borings will be determined by the results of the soil gas analyses and will be presented in the technical memorandum prepared at the end of Stage 1.

All boreholes will be drilled to a depth of six feet into bedrock. If sandstone is encountered in the six foot interval, the borehole will be continued through the sandstone until at least six feet of



LEGEND

- CT — 2-FOOT CONTINUOUS HOLLOW STEM AUGER CORE RUN
- LS — INTERVAL COMPOSITE LABORATORY SAMPLE FOR TAL METALS AND RADIONUCLIDES ANALYSIS
- SS — SURFACE SCRAPE SAMPLE FOR TAL METALS AND RADIONUCLIDES ANALYSIS
- V — DISCRETE LABORATORY SAMPLE FOR TCL VOLATILE AND SEMIVOLATILE ANALYSIS

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FIGURE 6-11
Borehole Schematic Showing Lithologic and Chemical Sampling

claystone is encountered. Figure 6-11 graphically illustrates the samples that will be taken from each borehole as described in the following paragraphs.

Surface scrape samples will be taken at the location of each borehole prior to initiating drilling. These samples will be analyzed for radionuclides and TAL metals (Table 6.4). At locations that are paved, instead of collecting a surface scrape, an alternate sampling method will be used. After the pavement has been removed, a grab sample of the material under the pavement will be taken with a steel scoop. Then another grab sample will be taken at either a depth of 4" below the bottom surface of the pavement, or at the surface of the next obvious soil change, whichever comes first. This sample will be analyzed for the same constituents as surface scrapes.

In each borehole, discrete samples will be taken at specified intervals during drilling for analysis of TCL volatiles (Figure 6-11). Samples for TCL volatile analyses will also be taken at the water table and at the alluvium-bedrock contact. Composite samples will be collected in each borehole from every 6-foot interval for analysis of TCL semivolatiles, TAL metals and radionuclides. All geologic materials will be continuously logged during drilling and 5 samples of alluvium and 5 samples of bedrock will be taken from boreholes throughout OU 13 for physical analyses (Section 6.5.2). All sampling activities will conducted in accordance with EG&G SOPs (Table 6.3).

Where boreholes are being drilled at the location of the highest level of contamination detected in the Stage 1 surveys, or where otherwise identified in the Stage 1 Technical Memorandum, groundwater samples will be collected from the borehole using the Hydropunch®, or equivalent, technology. An SOP for the Hydropunch®, or equivalent, technology will be developed as part of the Field Implementation Plan, and submitted to the regulatory agencies for review. The Hydropunch® will be lowered inside the hollow stem auger and then pushed or driven to a depth of at least 5 feet below the water table, if possible. Water samples will be collected for real time analysis of TCL volatiles and laboratory analysis of TCL volatiles and semi-volatiles, TAL metals, radionuclides, and anions (Table 6.4). Field measurements of pH, temperature, and specific conductance will also be performed.

Upon completion of borehole sampling activities, all boreholes will be plugged and abandoned in accordance with EG&G SOPs (Table 6.3), unless they have been identified to be completed as an alluvial monitoring well. All access holes cut into pavement will be patched with the proper material. If it is determined that a borehole should be completed as an alluvial monitoring well for risk assessment or contaminant characterization, it will be completed at this time in accordance with EG&G SOPs (Table 6.3). Any wells installed during Stage 2 will be analyzed for the constituents specified in Table 6.4. The wells will be sampled once as part of the RFI/RI. Subsequent sampling will be conducted under EG&G's sitewide monitoring program.

Due to access problems at certain IHSSs, it may not be possible to install boreholes in the locations indicated by the Stage 1 activities. Under these circumstances alternate locations for the boreholes will be evaluated based upon the results of Stage 1. For example, based upon the present location of fuel oil Tanks 221 and 224 within bermed areas in IHSSs 152 and 117.3 it is unlikely that boreholes can be drilled inside of the berms for these tanks. If contamination is detected during Stage 1 activities at these IHSSs, boreholes will be drilled outside of the bermed areas in those locations where the greatest potential exists for detecting such contamination.

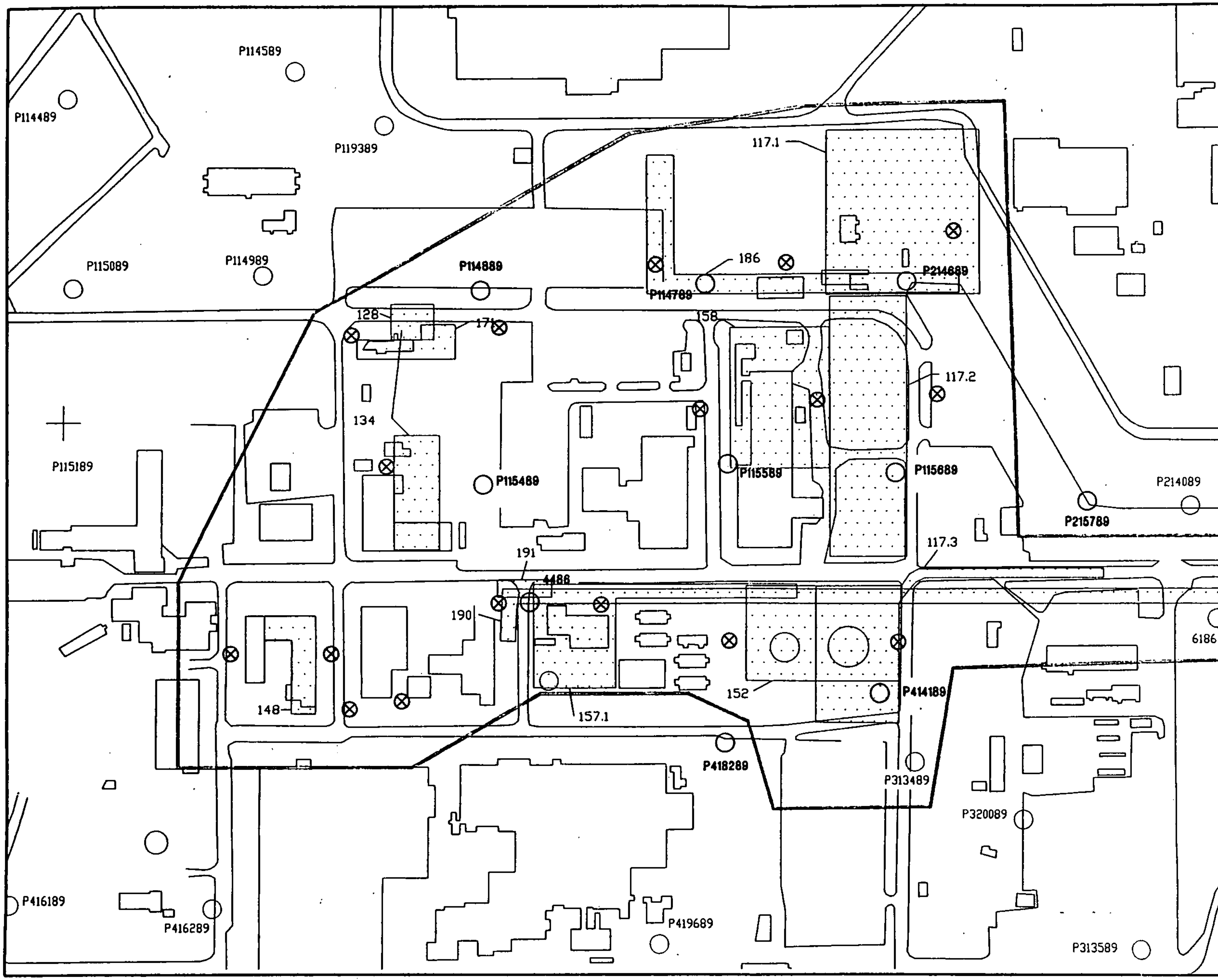
Upon the completion of Stage 2, the results of Stages 1 (including analyses of subsurface and surficial soil samples and groundwater samples) and 2 will be fully evaluated to determine if further investigation of each IHSS is necessary. If the data collected do not indicate that contamination exists at a particular IHSS, no further investigation of that IHSS will be necessary. If the borehole and groundwater data collected indicate that contamination exists at an IHSS, then the Stage 3 investigation of that IHSS will be initiated. The existence of contamination will be based on background concentrations provided in the Background Geochemical Characterization Report as described in Section 2.2 of this Work Plan. The results of Stages 1 and 2 and recommendations for further investigation will be documented in a technical memorandum. This technical memorandum will summarize the results collected and will outline the scope of the Stage 3 investigation, if necessary, for each IHSS, particularly if Stage 3 will require activities that are not described in this Work Plan. In addition, if the information obtained during Stages 1 and 2 indicates that a vadose zone monitoring program is required at any OU 13 IHSS(s), the details of this program will be included in this technical memorandum.

6.3.3 Stage 3 Investigation

The focus of the Stage 3 investigation will be to attempt to determine migration of contamination detected during Stages 1 and 2. The scope of the Stage 3 investigation is largely dependent upon the results of the Stage 1 and Stage 2 investigations. The number, location, and types of sampling points required cannot be precisely defined until Stages 1 and 2 have been completed and the data collected fully evaluated. The exact sampling locations will be determined on a case-by-case basis, taking into account the following factors:

- Environmental fate and transport of the specific contaminants;
- Contaminant concentrations;
- Expected depth to water table and bedrock;
- Nature of alluvium;
- Presence of any subcropping sandstone units in the bedrock; and
- Other pertinent data.

For scoping purposes, it is assumed that two alluvial groundwater monitoring wells will be required to be installed at each IHSS determined to be a source of contamination in Stages 1 and 2. One well upgradient and one well downgradient of these IHSSs will be installed. Whenever possible, existing wells and piezometers will be used for the Stage 3 investigation. Figure 6-12 provides preliminary locations of new wells to be installed and identifies those existing wells or piezometers that may be used during Stage 3. These locations will likely change based on the results of the Stage 1 and Stage 2 investigations and due to access problems. Based on the preliminary well locations identified in Figure 6-12, it is estimated that a maximum of 17 new wells will be installed during Stage 3. It is also estimated that a maximum of 10 existing wells and piezometers will be sampled during Stage 3. The final numbers and locations of wells to be installed will be specified in the technical memorandum prepared at the end of Stage 2. As discussed in Section 6.3.2, additional borings may be required in Stage 3. The need for and locations of these borings will be specified in the technical memorandum.



U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado

OPERABLE UNIT NO. 13
PHASE I RFI/RI WORK PLAN

FIGURE 6-12

STAGE 3
PRELIMINARY LOCATIONS OF GROUNDWATER MONITORING WELLS/PIEZOMETERS

During the drilling of new wells, borehole samples will be collected for analysis. The intervals sampled and the analytes for each sample will be the same as those defined above for Stage 2 (Table 6.4). If the Stage 1 and Stage 2 investigations indicate that a less extensive list of analytes will be required at any location, the analytes for samples obtained at that location will be specified in the technical memorandum submitted at the completion of Stage 2.

Groundwater samples will be collected from each well and analyzed for the list of constituents identified in Table 6.4. As with borehole samples, if a less extensive suite of analytes is required, the analytes for groundwater samples will be specified in the technical memorandum submitted at the completion of Stage 2. Samples will be collected from each new well immediately upon completion. Samples from existing wells and piezometers will be collected once at the time the Stage 3 investigation is initiated. Subsequent groundwater sampling will be performed as part of the site-wide monitoring program and will be arranged for by EG&G.

6.4 SAMPLING EQUIPMENT AND PROCEDURES

The following sections describe the sampling equipment and procedures to be followed in general terms. Details regarding each of the sampling procedures is provided in the SOPs referenced in the following sections and listed in Table 6.3.

6.4.1 Radiological Survey Procedure

Sampling locations are IHSS-specific and are discussed in Section 6.3. Radiological surveys will be conducted on 20-ft grids at all OU 13 IHSSs requiring such surveys unless visual inspection reveals that a larger grid size can provide 100 percent coverage of the investigation area. The established grids will provide approximately 100 percent coverage of the IHSS surface area. The HPGe has a broad energy range, exhibits high resolution, excellent gain stability, moderate area averaging, and the ability to identify and quantify all gamma- emitting radionuclides. The HPGe detector provides radionuclide concentrations in soil in picoCuries per gram (pCi/g) of gamma-emitting radionuclides including, but not limited to, potassium-40, radium-226, thorium-232, cesium-137, americium-241, plutonium-239, -240, and -241, and uranium-233, -234, -235, and -238. Tritium and strontium-90 are not detected using this method. The SOP for the HPGe is presently being finalized and will be available prior to any OU 13 field work. Other equipment requirements are listed in Section 5.2 of SOP FO.16

An additional component of the radiological survey described above includes real time measurement of radionuclide concentrations in surficial soils and in vertical profile samples using a laboratory HPGe detector. Surficial soils and vertical profile samples collected via procedures in Section 6.4.3 will be surveyed with a laboratory detector to obtain radionuclide concentrations. The samples will be held for 30 days in a closed container to allow radon gas to equilibrate with parent radionuclides present in the soil. After the 30-day period, the radon activity measured will be representative of radionuclides, particularly radium, present in the soil sample.

At IHSSs where radionuclide concentrations in the soil beneath pavement are of interest, the surfacing materials block most of the gamma ray emissions associated with the source below the pavement. It is likely, however, that if the source was highly radioactive, a radioactive anomaly should be detectable. Therefore, two methods of investigation will help insure that those areas are identified. First, results will be carefully evaluated. Then a few random asphalt samples will be taken to compare with the HPGe readings. The asphalt samples will be taken with a plug type corer and measured with either standard radiochemical analysis or with an onsite laboratory HPGe instrument. The SOPs for both the asphalt sampling and analysis and the laboratory HPGe instrument are currently being developed. They will be submitted to the regulatory agencies for approval prior to use in the field.

The second method is to take a soil sample as part of the surficial soils sampling plan from below the pavement and have it analyzed for radionuclides. The procedure for sampling below the pavement is currently being revised and will be submitted to the agencies for their approval prior to using the procedure in the field. Basically, the pavement will be removed and a grab sample will be taken of the material directly below the pavement. After that sample is taken, another grab sample will be taken from the surface of the next obvious soil horizon (roadbase or preparation) bed (soil interface), or 4 inches below the bottom surface of the pavement, whichever occurs first.

6.4.2 Soil Gas Survey

Real time soil gas sampling will be conducted at specific OU 13 IHSSs presented in Section 6.3 according to procedures in SOP GT.9. Soil gas samples will be collected through a 1-inch diameter stainless steel probe rod driven with a hydraulic rig mounted on a vehicle. In paved locations, an access hole will be cut through the pavement prior to driving soil gas probes. In areas where vehicle access is not possible, the insertion of the soil gas probes by hand will be attempted. The probe is a hollow steel rod with a retractable tip allowing for the soil vapor entry into the tip. The samples will be recovered with a vacuum gas sampling system connected by vacuum hose directly through the probe to the sampling tip. The sample is to be collected with a gas-tight syringe and injected directly to the gas chromatograph (GC). Alternative soil gas techniques, such as passive collection methods, may be utilized if site conditions warrant it. Detection limits for soil gas analysis are specified in Table 5.3.

6.4.3 Surficial Soil Sampling Procedure

Surficial soil sampling for radionuclide and metal analysis will be conducted in accordance with SOP GT.8 using two methods depending on the presence of pavement or concrete. The Rocky Flats sampler (jig and scoop RFP method) will be used to collect surficial soils for radionuclide analysis at OU 13 IHSSs that are not covered by asphalt or concrete. This method uses a one square meter template that locates five subsamples at each sample location which is composited for analysis. (Details of this method can be found in Technical Memorandum No. 5 to the Phase III Work Plan for OU 1.) At survey points covered with pavement, a single 0- to 2-in grab will be collected after the pavement has been cored, preferably with a plug-type sampler. An additional sample below the surface of the next obvious soil horizon (preparation/roadbase horizon) or four inches below the bottom surface of the pavement will also be taken. An SOP is being developed to describe sampling for radionuclides and other parameters from beneath paved areas, and will be submitted to the regulatory agencies for approval prior to the initiation of sampling.

The samples will be analyzed on site with the HPGe detector for radionuclides. Surface samples representing a range of radionuclide concentrations will be surveyed with the detector and sent to an offsite laboratory for radionuclide analysis and verification. Surficial soil samples from selected IHSSs will also be submitted to an offsite laboratory for determination of TAL or specific metals.

6.4.3.1 Surficial Soils Sampling - Vertical Profiles

Vertical soils profiles are required to help in the interpretation of HPGe data. At least two locations are selected from each IHSS group; one from a location showing little or no radioactivity, and the other from an area of the highest measurement of radioactivity.

The soil profiles themselves are taken from the six inches of soil. Separate grab samples are taken with a steel scoop at the 0-2" interval, the 2"-4" interval, and the 4"-6" interval.

These samples are analyzed by both radiochemical analysis and laboratory HPGe. The SOP for vertical profiling is being revised and will be submitted to the regulatory agencies for review before it is used in the field.

6.4.4 Borehole Drilling and Soil Sampling Procedures

Borings will be drilled to determine the geotechnical characteristics of the soil, to further investigate trends identified in screening tasks, to collect samples for physical and chemical analysis, and to install monitoring wells. Before any boreholes are drilled, utilities will be located and the drill site will be cleared in accordance with SOP GT.10.

Borings drilled for the purpose of documenting soil contamination will be drilled to the water table or six feet below the alluvial-bedrock contact, whichever is encountered first. Drilling the six-foot bedrock interval will allow a complete sample representative of bedrock conditions to be collected and analyzed. If sandstone is encountered in the six foot interval, the borehole will be continued through the sandstone until at least six feet of claystone is encountered. In monitoring well borings, soils collected from beneath the water table will not be submitted for chemical analysis, and borings will be advanced only three feet below the bedrock contact.

Hollow-stem auger drilling will be conducted in accordance with SOP GT.2, except where material is impenetrable with this method. If augering is ineffective, rotary drilling will be used in accordance with SOP GT.4. Rotary drilling will only be used in situations where material is impenetrable, with hollow-stem augering the method of choice. At locations with shallow borings where the drill rig cannot enter, hand augers will be used in accordance with guidelines in SOP GT.2 and GT.8.

All drill cuttings and soil samples will be surveyed for radionuclides and organic vapors in accordance with SOP FO.15, Use of Photoionizing and Flame Ionizing Detectors, and SOP FO.6, Field Radiological Measurements. Investigation-derived wastes, such as drill cuttings and residual samples, will be handled according to guidelines in SOP FO.8 and FO.9.

All equipment must be decontaminated before and after drilling and sampling takes place in accordance with the procedures outlined in the SOP FO.3 and FO.4. Decontamination water will be handled according to guidelines in SOP FO.7.

All of the borings not identified to be completed as monitoring wells will be grouted and abandoned immediately after drilling in accordance with procedures outlined in SOP GT.5. Procedures specified in this SOP are designed to prevent vertical migration of contaminants after abandonment.

Soil and bedrock samples will be collected during drilling for visual logging in accordance with SOP GT.1 and for chemical and physical analysis in accordance with SOPs GT.2 and FO.13. The soil and bedrock samples will be collected using a hollow-stem auger with a continuous-core sampler. Continuous core will be collected for geologic descriptions for the entire borehole depth. From this core, discrete, 2-ft samples will be submitted for laboratory volatile organic analyses (VOA) as shown in Figure 6-11. In addition, a discrete VOA sample will be collected at the water table and at the alluvium-bedrock contact. VOA soil samples should be collected in core liners that are capped and sealed upon recovery. In addition to the VOA samples, linear depth composite samples from the core will be submitted to the laboratory for analysis of the remaining chemical parameters from every consecutive 6 ft interval to the water table.

Soil samples for geotechnical analysis require a minimum amount of disturbance and will be collected in thin-walled metal tubes. The thin-walled metal tube will be driven into the undisturbed soils in advance of the hollow-stem auger, removed, and the tube sealed for transport to the laboratory. Any changes to these geotechnical sampling procedures will be the subject of a document change notice.

6.4.5 Asphalt/Concrete Sampling Procedure

Asphalt and/or concrete samples will be collected at some IHSSs where the potential exists that releases resulted in contamination of the asphalt/concrete. These samples will consist of two small-diameter (approximately 1-inch) core plugs. The core plugs will be collected using a hand core drill. The samples will be handled in accordance with SOP FO.13 and will be analyzed for gamma-emitting radionuclides with a laboratory HPGe. The SOP for the laboratory HPGe is currently under development and will be submitted to the agencies for approval prior to its use.

6.4.6 Installing and Sampling of Groundwater Monitoring Wells

All monitoring wells will be constructed with materials specified in SOP GW.6. A hollow-stem auger with an inner diameter a minimum of 4 inches larger than the well casing outer diameter will be used to drill the monitoring wells so as to produce a minimum annular space of 2 inches. Well construction techniques will follow procedures outlined in SOP GT.6. Investigation-derived wastes such as cuttings and residual samples will be handled in accordance with guidelines outlined in SOP FO.8.

Well construction techniques for all monitoring wells will follow procedures contained in SOP GT.6. Monitoring wells in high-traffic paved areas will be completed flush with the pavement. Wells in areas not exposed to vehicular traffic will be protected by the placement of steel posts around the monitoring wells, as described in SOP GT.6. Pressure grouting procedures will follow guidelines outlined in SOP GT.3. Additional equipment and materials that may be needed for

monitoring well installation are listed in SOP GT.6, Section 5.1; other related SOPs are cross-referenced in Section 4.2 of SOP GT.6.
The wells will be developed no sooner than 48 hours and no longer than two weeks after completion and will not be sampled until at least two weeks after development. Water levels will be measured in all wells and recorded as outlined in SOP GW.1 and the appropriately cross-referenced SOP listed in Section 4.2 of SOP GW.1. After the water levels reach static conditions, the wells will be developed utilizing low-energy methods, such as an internal pump or bottom discharging bailer. Well development will follow procedures outlined in SOP GW.2.

Prior to groundwater sampling, three to five casing volumes of water will be purged from the well by either bailing or pumping. Purging procedures will follow those contained in SOP GW.6. Field parameters (pH, specific conductance, temperature) will be measured after every half casing volume is removed as described in SOP GW.6.

Groundwater samples will be collected in a manner that will minimize the amount of agitation or limit the exposure of the sample to the atmosphere. Groundwater sampling will be by bailing or the use of bladder or peristaltic pump. Samples will be collected, handled, and screened in accordance with SOP GW.6 and all related SOP.

All development and purge water will be handled in accordance with guidelines outlined in SOP FO.8. Equipment needed for groundwater sampling is listed in SOP GW.6.

Field parameters will be measured when each groundwater sample is collected. Specific conductance, pH, and temperature will be measured when groundwater samples are collected in accordance with SOP GW.6. Water level measurements will be conducted in accordance with SOP GW.1 and the appropriately cross-referenced SOP listed in Section 4.2 of this SOP GW.1.

Collection of groundwater samples with the Hydropunch® is not addressed by a current SOP. One will be developed prior to initiating sampling activities. Because a relatively large volume of sample is required for the analyses specified in Section 6.3.3, the Hydropunch II®, or equivalent, sampler will be used. The Hydropunch II® will be lowered inside a hollow stem auger and then pushed or driven to a depth of at least 5 feet below the water table, if possible. Once the sampler is in place, the body of the sampler is pulled back allowing groundwater to flow into the tool. A small diameter bailer is then inserted into the tool for collection of a sample. Once sampling is complete, the tool can be pulled from the ground; however, a sacrificial screen remains in place.

6.4.7 Sump Sampling Procedure

Standing water in the sump located within IHSS 171 will be sampled for the parameters specified in Section 6.3.1.10. The water in the sump will be collected in accordance with Section 5.3.3 of SOP SW.3. The water will also be analyzed in the field for temperature, pH, and specific conductance.

6.4.8 Surveying of Sample Locations

The locations of all radiometric survey points, soil gas survey points, borings, and surface sampling points will be determined prior to sampling or drilling. After sampling, drilling, or well installation, locations will be surveyed using standard land surveying techniques described in SOP GT.17. Horizontal accuracy will be ± 0.5 ft for surficial soil samples, soil gas survey points, and borings and ± 0.1 ft for temporary well point locations and wells. Three elevations will be determined for each well: ground surface, top of well casing, and top of surface casing.

6.5 SAMPLE ANALYSIS

6.5.1 Soil Gas Analysis

Soil gas samples will be analyzed for the parameters specified for each IHSS in Sections 6.3.1.1 to 6.3.1.11. The SOPs applicable to the analysis of soil gas samples are specified in Table 6.3. Detection limits for these analyses are specified in Table 5.3.

6.5.2 Borehole Samples

6.5.2.1 Chemical Analysis

Borehole samples will be collected for chemical analysis from surficial materials and weathered bedrock, as discussed in Sections 6.3.2 and 6.3.3. Section 6.3.2 and Table 6.4 designate borehole samples for analysis and provide the chemical parameters that the samples will be analyzed for. The detection limits for these analyses are specified in Table 5.3.

6.5.2.2 Physical Analysis

Physical analysis of five samples of alluvium and five samples of bedrock from random boreholes throughout OU 13 will be performed. Physical analysis on alluvium and bedrock samples will consist of classification (ASTM [American Society for Testing and Materials] D2488), moisture content (ASTM D2216), and dry density for intact samples (ASTM D2216). Laboratory classification tests will consist of grain size distribution (ASTM D422) (including hydrometer analysis) and Atterberg limits (ASTM D4318).

6.5.3 Groundwater Samples

Groundwater samples will be collected from existing wells and piezometers identified in Sections 6.3.1.1 to 6.3.1.11 and from new and existing wells and piezometers as identified in Section 6.3.3. Samples will be measured in the field for pH, specific conductance, and temperature in accordance with the procedure specified in Table 6.3. Table 6.4 lists the analytical parameters for groundwater samples for the Stage 1 investigation. Subsequent sampling iterations may require analyses of a less extensive suite of analytes as specified in Section 6.3.3. Laboratory analyses for dissolved metals will be performed on samples filtered in the field using a 0.45 μm cellulose acetate filter prior to sample preservation.

6.5.4 Sample Containers and Preservation

The type of analysis and media to be sampled dictates the sample container volume and material requirements, preservation techniques, and holding times. Information relating to sample containers and preservatives is provided in SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples. The parameters specific to OU 13 with the corresponding containers, preservative, and holding time are listed in Table 6.5.

6.5.5 Sample Handling and Documentation

Sample control and documentation is necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, sample labels or tags, chain-of-custody forms, photographs, and analytical records and reports. Specific guidance describing container labeling, decontamination, field packaging, chain-of-custody records, field data documentation, packaging and shipping is provided in SOP FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples.

Field data and reporting requirements are discussed in detail in SOP FO.14 Field Data Management. In general the following procedures must be followed:

- Collection of data on pre-printed forms;
- Preliminary verification of the data;
- Technical verification by a qualified verifier;
- Data input into the Rocky Flats Environmental Data System (RFEDS);
- Verification of input;
- Archive and filing of data;
- Security of database and computers;
- Documentation of implementation of the referenced SOP; and
- Use of data management forms.

TABLE 6.6
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
FOR SOIL AND WATER SAMPLES

SOIL SAMPLES			
Parameter	Container	Preservative	Holding Time
TAL Metals	1 x 250 ml wide-mouth glass jar	None	180 days**
TCL Volatiles	2 x 125 ml wide-mouth glass vials	Cool, 4 degrees C	7 days
TCL Semivolatiles	1 x 250 ml wide-mouth glass jar	Cool, 4 degrees C	7 days until extraction 40 days after extraction
Radionuclides *	1 x 1l wide-mouth glass jar	None	None
WATER SAMPLES			
Parameter	Container	Preservative	Holding Time
TAL Metals	1 x 1l polyethylene bottle	Nitric acid pH<2; Cool, 4 degrees C	180 days**
TCL Volatiles	2 x 40 ml VOA vials with teflon-lined septum lids	Cool, 4 degrees C	7 days
TCL Semivolatiles	1 x 4l amber glass bottle	Cool, 4 degrees C	7 days until extraction 40 days after extraction
Radionuclides	1 x 12.0l polythylene bottle	Nitric acid pH<2	180 days
Anions	1 x 1l polyethylene bottle	Cool, 4 degrees C	28 days
Nitrate/Nitrite	1 x 2l polythylene bottle	Sulfuric acid pH<2 Cool, 4 degrees C	28 days
Sulfate	125 ml HPDE bottle	Cool, 4 degrees C	28 days
pH, Temperature, andspecific	In situ, beaker or bucket	None	Analyze immediately

* This container is suitable for asphalt samples.
** Holding time for mercury is 28 days.

6.5.6 Sample Designation

The Rocky Flats Environmental Data System (RFEDS) requires all sample designations to be consistent. Each sample designation will contain a nine-character sample number consisting of a two-letter prefix that relates to the type of sample collected (e.g., "SB" for soil borings, "SS" for surface soils), a unique five-digit number, and a two-letter suffix identifying the contractor. One sample number will be required for each sample generated, including quality control samples. Using this system, 99,999 unique sample numbers are available for each sample media per contractor. Boring numbers will be developed independently of the sample number for a given boring; however, the boring number and sample number are linked so that data for particular samples can be related to the boring from which the sample was taken. These sample numbering procedures are consistent with the RFP sitewide QAPjP.

6.6 FIELD QC PROCEDURES

Sample duplicates, field preservation blanks, and equipment rinsate blanks will be prepared. Trip blanks will be obtained from the laboratory. The analytical results obtained for these samples will be used by the EMD project manager to assess the quality of the field sampling effort. The types of field QC samples to be collected and their application are discussed below. The frequency with which QC samples will be collected and analyzed is provided in Table 6.6.

Duplicate samples will be collected by the sampling team for use as a relative measure of the precision of the sample collection process. These samples will be collected at the same time, using the same procedures and equipment, and placed in the same types of containers as required for the samples. They will also be preserved in the same manner and submitted for the same analyses as required for the samples.

Field blanks of distilled water, preserved according to the preservation requirements (Section 6.5.4), will be prepared by the sampling team and will be used to provide any indication of any contamination introduced during field preparation. As indicated in Table 6.6, these QC samples are applicable only to samples requiring chemical preservation.

Equipment (rinsate) blanks will be collected from final decontamination rinsate to evaluate the success of the field sampling team's decontamination efforts on non-dedicated sampling equipment. Equipment blanks are obtained by rinsing cleaned equipment with distilled water prior to sample collection. The rinsate is collected and placed in the appropriate sample containers. Equipment blanks are applicable to all analyses for water and soil samples and for organics analysis of soil gas samples, as indicated in Table 6.6. Equipment blanks for soil gas sampling will consist of blanks taken and analyzed to check background contamination in the sampling system and cartridges (see SOP FO.09).

Trip blanks consisting of ASTM Type II laboratory reagent water will be prepared by the laboratory technician and will accompany each shipment of samples for VOCS analysis. Trip blanks will be stored with the group of samples with which they are associated. Analysis of the trip blank will indicate migration of VOCs or any problems associated with sample shipment, handling, or storage. Trip blanks for soil gas analysis will consist of an unused sample cartridge transported into the field with the sampling equipment. The trip blank cartridge will be handled in the same manner as a sample, but a sample will not be collected through this cartridge.

TABLE 6.7
FIELD QC SAMPLE FREQUENCY

Sample Type	Type of Analysis	Media: Solids	Media: Liquids	Media: Soil Gas
Duplicates	Organics	1/10	1/10	1/10
	Inorganics	1/10	1/10	N/A
	Radionuclides	1/10	1/10	N/A
Field Preservation Blanks	Organics	N/A	N/A	N/A
	Inorganics	N/A	1/20	N/A
	Radionuclides	N/A	1/20	N/A
Equipment Blanks	Organics	1/20*	1/20*	IPD
	Inorganics	1/20*	1/20*	N/A
	Radionuclides	1/20*	1/20*	N/A
Trip Blanks	Organics	NR	1/20	1/20
	Inorganics	NR	NR	N/A
	Radionuclides	NR	NR	N/A

NA = Not Applicable
NR = Not Required
1/10 = 1 QC sample per 10 samples collected
1/20 = 1 QC sample per 20 samples collected
1/20* = 1 QC sample per 20 samples collected or 1 QC sample per day whichever is more frequent
1PD = 1 QC sample per day and prior to reuse of recleaned sampliing equipment

TITLE: DQOs Approved By:

04/01/93
Effective Date

Manager

/ /
Date

7.0 TASKS AND SCHEDULING

The Interagency Agreement (IAG) schedule for conducting the OU 13 Phase I RFI/RI is summarized in Figure 7-1. The IAG schedule includes the established milestones and includes contingencies for regulatory review of a brief Technical Memorandum to be prepared after Stage 2 of the FSAP. The schedule does not address issues related to obtaining contractual authorization to proceed. Laboratory turnaround time for reporting analytical results is assumed to take 21 days; data validation is assumed to require an additional 30 days, and both have been factored into the schedule. Approximately two years will elapse from the time the Work Plan is implemented until the final RFI/RI Phase I report is issued.

Several key elements of the Work Plan overlap chronologically. This reflects both the flexibility designed into the Work Plan and the need to implement the Work Plan on an aggressive schedule.

Data validation will begin approximately one month after the site characterization task begins in anticipation that sufficient data will be generated from this stage of the RFI/RI until its completion. It will therefore be necessary to utilize a full-time data validation staff. Implementing data validation concurrent with site characterization will assist in the refinement of data collection procedures and in completing RFI/RI activities within the time frame established in the IAG.

IAG OU13 RFI/RI Schedule

ID	Name	Start	Finish
1	Submit Draft Phase I Workplan	Apr 15 '92	Apr 15 '92
2	EPA/CDH/LRA Review	Apr 15 '92	Aug 3 '92
3	Prepare Final Phase I Workplan	Jul 21 '92	Oct 12 '92
4	Submit Final Phase I Workplan	Oct 12 '92	Oct 12 '92
5	Prepare Project Mgmt. Plans	Nov 15 '92	Dec 11 '92
6	EG&G/RFP/DOE Review & Approval	Dec 14 '92	Jan 29 '93
7	Implement Community Relations Plan	Feb 1 '93	Jan 11 '95
8	Site Charracterization	Feb 1 '93	Oct 22 '93
9	Site Physical Characterisitics	Feb 1 '93	Jul 30 '93
10	Data Validation	Mar 15 '93	Dec 17 '93
11	Conduct Risk Assessment	Nov 1 '93	Mar 4 '94
12	Evaluate Remedial Technologies	Jan 10 '94	May 13 '94
13	Select Remedial Technology	Feb 21 '94	Jun 10 '94
14	Prepare Draft Phase I Report	Apr 4 '94	Aug 8 '94
15	Submit Draft RFI/RIPhase I Report	Aug 8 '94	Aug 8 '94
16	EPA, CDH, LRA Review	Jul 12 '94	Nov 14 '94
17	Prepare Final RFI/RI Phase I Report	Oct 18 '94	Jan 11 '95
18	Submit Final RFI/RI Phase I Report	Jan 11 '95	Jan 11 '95

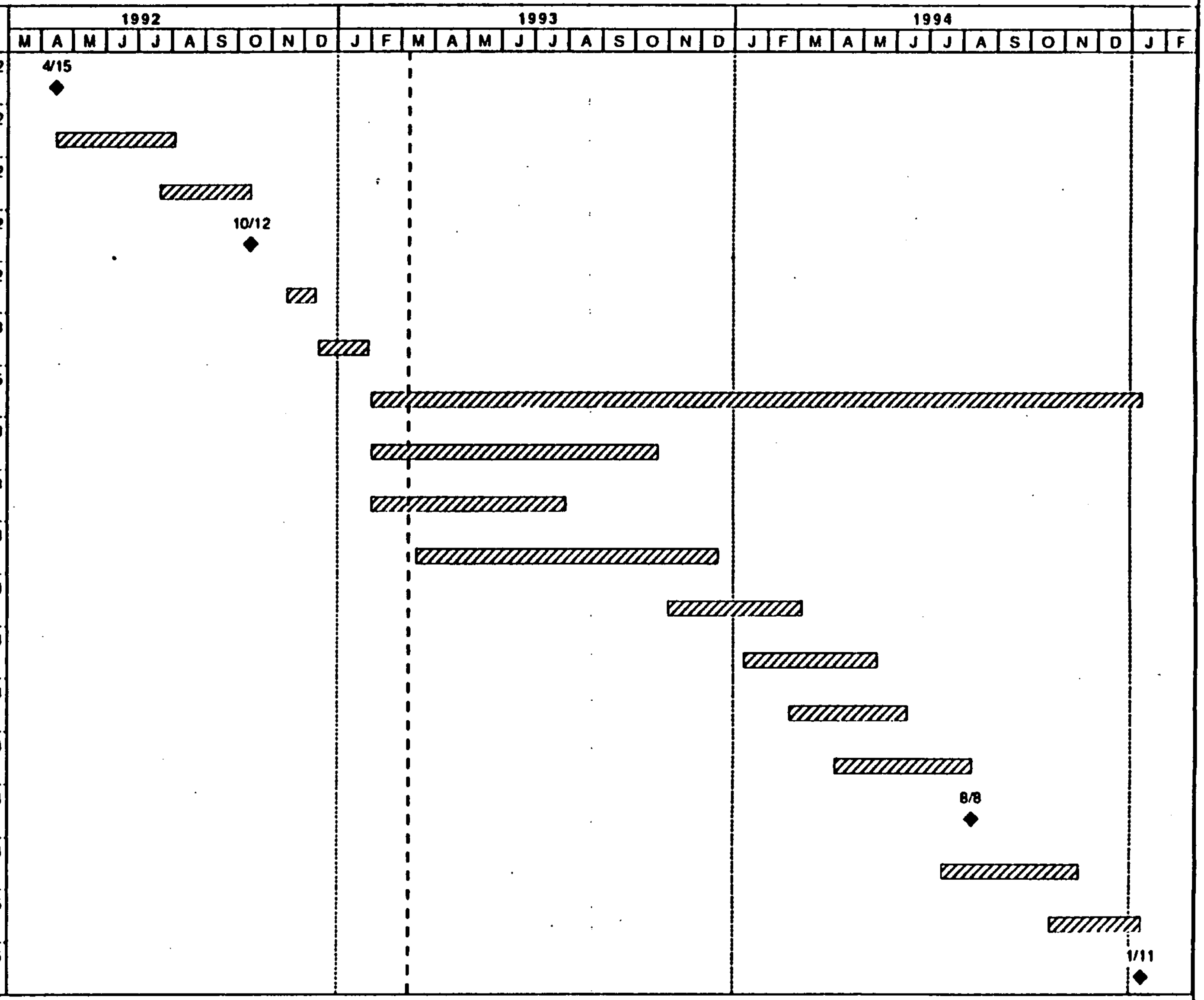


FIGURE 7-1

Critical Noncritical Progress Milestone Summary Rolled Up